Knowledge & Scientific News

A MONTHLY JOURNAL OF SCIENCE.

Conducted by MAJOR B. BADEN-POWELL, F.R.A.S., and E. S. GREW, M.A.

VOL. II. No. 10. [NEW SERIES.] SEPTEMBER, 1905. [Entered at Stationers' Hall] SIXPENCE NET.

CONTENTS.—See Page VII.

The Sun in Calcium Light.

By WILLIAM J. S. LOCKYER, M.A., PH.D., F.R.A.S.

II.

THE loaded plate-holder is next slid into its carrier, and both secondary slit and carrier are securely wrapped in velvet as is consistent with the necessary freedom of relative movement during the exposure. The window blinds in the room containing the instrument are then closed to keep out daylight as much as possible. By pushing the whole upper framework towards the east, the solar image is made to lie a little to the west of the primary slit. The length of exposure required is now judged by the brightness of the solar image, and the rate of movement adjusted according to a reading taken from a table giving the lengths of "runs" corresponding to the temperature of the oil. The dark slide is next opened and a suitable moment for exposure awaited. When this opportunity occurs the shutter behind the primary slit is opened and the framework released by a starting handle.

The primary slit then moves over the fixed solar image and simultaneously with it the secondary slit passes over the fixed photographic plate; the "K" image is thus built up in the form of a disc. The time of transit of the slit over the image is indexed as the "run," and when completed the slit shutter and plate are closed.

The operations for obtaining the photographs of the prominences round the limb are very similar to the above. The solar image falling on the primary slit is blocked out by means of a metal disc of the same size as this image, and a much longer exposure is given. The ratio of the length of a "disc" and "limb" exposure is about as 1 to 60. Under very favourable circumstances a "disc" exposure lasts about 15 seconds.

By taking a limb photograph first, and then removing the metal disc and making another "run" for the "disc," a composite picture on one plate is secured.

Since this spectroheliograph has only been working efficiently since the spring of last year (the recent winter months being excluded as the low altitude of the sun in London during this period renders this kind of work almost impossible), the data at present available for discussion are not very considerable.

It will, however, not be without interest to refer to some of the photographs obtained, which will serve to illustrate not only the quality of the negatives secured, but the different branches of work which such a series of photographs as previously mentioned open up.

In the accompanying illustrations will be found two enlarged reproductions, one of the solar disc in "K" light, taken on September 20, 1904 (Plate II.), and another of a composite picture showing the limb and disc taken on August 29 of the same year (Plate III.).

From a general examination of a great number of the "disc" negatives it has been noted that over the whole solar surface there is always a very distinct "mottling" extending even to the solar poles.

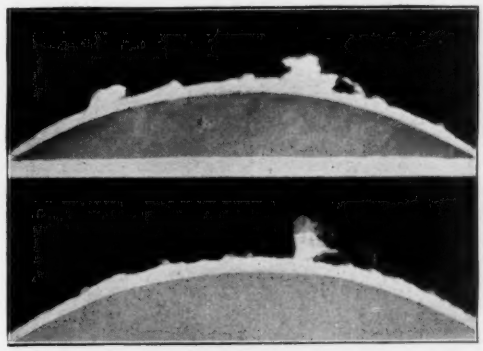


Fig. 4.—Illustrating a striking change in a prominence after an interval of one hour. July 14, 1904.

About the equatorial regions this mottling seems in places to be of an enlarged nature and unevenly distributed in longitude. In regions of apparently greater disturbance the bright portions of this mottling become amalgamated and produce the calcium clouds or "flocculi," as termed by Prof. Hale. The type of formation of these flocculi can be gathered from the illustration (Plate I., Fig. 2) given last month. A bright nucleus with radiating bright branches is not an uncommon feature in a great number of the plates examined.

It is in these larger flocculus regions that spots are observed. There can be flocculi without spots and flocculi with spots, but, so far as the photographs have shown, never spots without flocculi. The duration of a spot is, further, only a brief interval in the life history of a flocculus, so that to study the formation of spots their relation to flocculi must be taken into account. That an intimate connection in addition to that mentioned above does exist, is indicated by the fact that spots appear more generally to precede the apparent trailing masses of flocculi with respect to the solar

XUM

rotation. Some examples of these are shown in one of last month's illustrations (Plate I. Fig. 3).

These " K " line photographs of the disc of the sun will thus form the means of helping to solve many of the solar riddles. Several other equally interesting points to be investigated might be mentioned.

By photographing the solar limb and the disc on the same plate a means is afforded of noting the behaviour of prominences with reference to the flocculi. Thus it has been observed that although the " K " prominences near the solar poles are sometimes of very great dimensions, the mottling on the disc in these latitudes is always regular and apparently undisturbed. Again, a large prominence on the approaching limb of the sun in lower latitudes does not always herald the presence of a large flocculus region on the disc at the same position angle, neither does a flocculus passing round the limb necessarily indicate the position of a large prominence. In fact, it seems that although there may be some relation between prominences and flocculi, it is not a very close one so far as can be judged by the few photographs already discussed.

The spectroheliograph affords a very excellent means of studying the sequence of changes in the form of prominences. If the instrument be set up in low latitudes where the altitude of the sun is high at noon all the year round, and, consequently, the length of exposure necessary can be reduced to a minimum, a wealth of valuable information could be gleaned. In these latitudes, even in summer, opportunities are not very numerous owing to the frequency of cloudy days.

To illustrate the nature of such photographs one

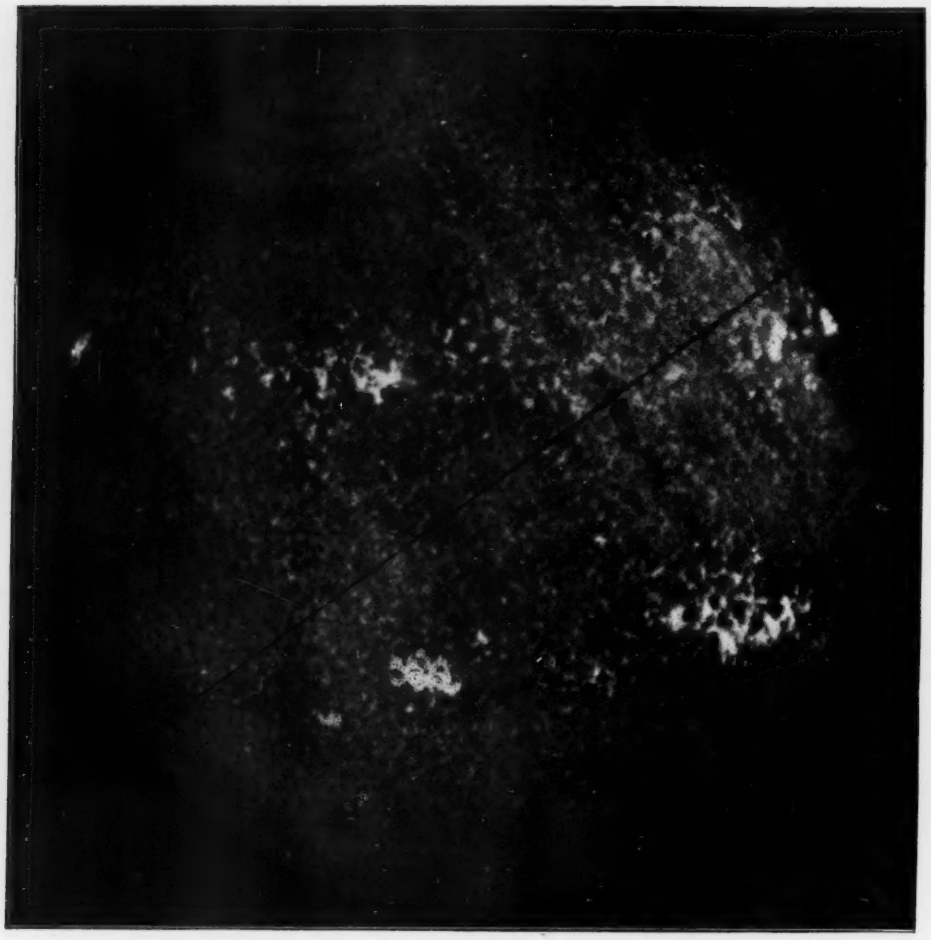


PLATE II.—Sun's Disc Photographed in "K" (Calcium) Light. September 20, 1904.

Exposed from 10 h. 23 m. 0 s. to 10 h. 26 m. 10 s. (interval 70 sec.).

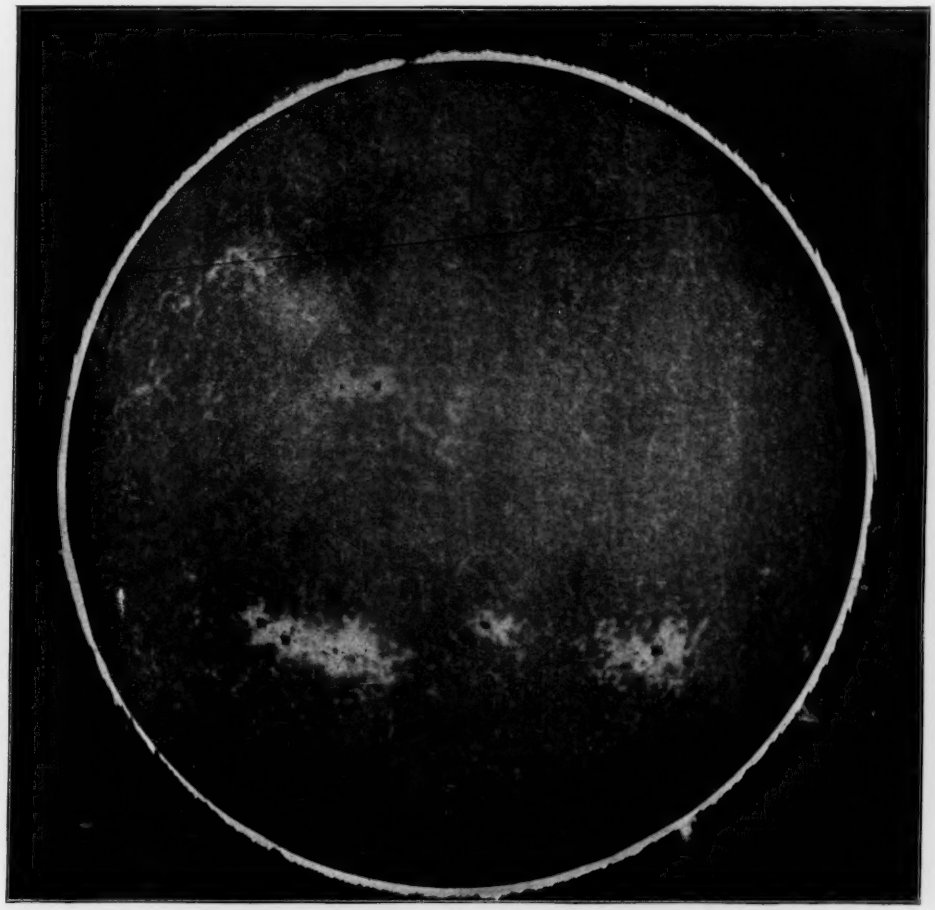
(Enlarged 2½ times.)

example is here given. This is shown in Fig. 4, and was secured on July 14 of last year, and the plates were exposed at 11h. 8m. a.m., and 12h. 8m. p.m. respectively. It will be seen that during this interval of about one hour a very decided change of form in the largest prominence has occurred. Instead of the somewhat symmetrical shape that existed at the first of these times the prominence is most intense on the left-hand side, and the material appears to be thrown towards the right as if acted upon by a strong current. Its height, at the same time, has been considerably increased. The other very intense but smaller prominence has almost disappeared during the same interval.

For very rapid changes of form in individual prominence, that is, changes that occupy only a few minutes of time, the visual method must still be employed, a most convenient form of instrument for this purpose being the Evershed form of spectroscope.

From the above somewhat cursory account of this spectroheliograph and its first fruits, it is hoped that some of our more wealthy readers will be induced to take up the work and carry out one or more of the numerous branches of this research which are as yet untouched. Although the initial expense is somewhat costly, the investigation of the sun by this instrument is so full of interest that the labour involved is sure to be well repaid.

N



W E

S

PLATE III.—The Sun as Photographed in "K" Light on August 29, 1904.

Exposure for Limb 2 h. 49 m. to 3 h. 13 m. G.M.T. (interval 24 m.).

Exposure for Disc 3 h. 16 m. 5 s. to 3 h. 16 m. 30 s. G.M.T. (interval 25 s.).

XUM

The N-Rays of Blondlot

By J. J. STEWART, M.A., B.Sc. (*Principal of the Technical Institute, Newport*).

IN the early summer of the year 1903 M. Blondlot, of Nancy, published in the *Comptes Rendus* of the French Academy of Sciences an account of some remarkable experiments he had carried out on certain rays which were emitted by a gas burner. He found that an ordinary Auer burner sent out rays resembling those of light and capable of penetrating metals, black paper, wood, cardboard, &c. The rays, after passing through these obstacles in their path, were able to produce effects in the region beyond. These effects manifested themselves especially by their behaviour towards a small electric spark which they caused to become noticeably brighter. A record of this action was obtained by M. Blondlot, who arranged a pair of sensitive photographic films so that one was acted upon by the ordinary electric spark from a small induction coil, the other by the spark from the same coil under similar conditions except that in the second case the spark was excited by the presence of the rays and had thus become brighter. The enhanced brilliance of the spark is indicated by the different effects on the sensitive film, and pictures of the two films, one exposed to the action of a succession of sparks under the influence of the rays from the Auer burner for 40 seconds, and the other with the rays from the Auer burner cut off by the interposition of moistened paper, are given in an early paper by M. Blondlot. The absorption of these new rays by water, especially water containing salt in solution, or by moist paper is one of their remarkable and unexplained characteristics.

The emission of these rays was noticed by M. Blondlot when using a Crookes tube for the production of Röntgen rays. He was led to suppose that they were to be very generally met with and were given out by various sources of light and heat, such as an Auer burner or a piece of heated metal. As these researches were carried out at the University of Nancy, where M. Blondlot is one of the professors, he gave to the radiations the name of N-rays from the first letter of the name of the town. Experiments on the behaviour of the N-rays seemed to indicate that they were capable of refraction and polarisation like the rays of ordinary light, and a beam of the rays appeared to be made up of different rays of very various refrangibility.

Another strange property of the new rays was that of increasing phosphorescence. Thus, if the N-rays concentrated by a quartz lens were caused to strike upon a screen of sulphide of calcium already phosphorescing, the phosphorescence was increased. This has been used as a means of detecting the presence of the rays, but the effect of heat on phosphorescence is very similar.

Further investigation of the N-rays seemed to indicate that they were given out by all bodies in a state of strain—by a bent piece of steel, a stretched or bent rod, or a file in which, during the process of manufacture, the material was subjected to stress resulting in a state of permanent strain. Extraordinary accounts were given of the emission of N-rays from pieces of metal, such as old weapons found in excavated cities or amongst the remains of buildings dating from Roman times in the south of France.

Bending or stretching wood or metal was found to cause the emission of N-rays, which generally manifested themselves by causing increased phosphorescence in sensitive substances. Sonorous vibrations were next observed as exciters of N-rays. M. Macé de Lepinay gave an account of experiments which showed increased luminescence of sulphide of calcium in the presence of sonorous bodies, such as cylinders of bronze when set in vibration. Even the alternate compressions and rarefactions of the air when transmitting the vibrations of sound seemed sufficient to originate N-rays and increase the brightness of a phosphorescing screen.

Further investigations by Blondlot led him to describe the dispersion of N-rays when refracted through prisms made of aluminium. As source of the N-rays in these experiments a Nernst lamp was used shut up in a cylinder of sheet iron in which a slit for the exit of the rays was arranged, which was closed by a sheet of aluminium permeable to the rays. The issuing N-rays were caused to pass through an opening in moistened cardboard (itself impermeable to them), and thus a beam of the rays was got, which was caused to pass through the aluminium prism and appeared to go out from it by another face, making an angle with the first, signs of dispersion by the prism being given in a way analogous to that of beams of light. The N-rays were drawn out into a spectrum—they appeared to be made up of various rays differing in wave-length. Measurements of the length of wave are given by M. Blondlot in his papers. He endeavoured to get a measurement of it by a sort of grating, and diffraction fringes were obtained. The phenomena of Newton's rings were also observed, and a whole series of phenomena resembling those obtained with waves of light.

Photography was employed to give a record of the changes of brightness produced by the N-rays, and the results got by Blondlot were confirmed by various observers in France. A remarkable thing about the repetition and confirmation of these experiments was that they occurred only in France. Observers in other countries endeavoured to repeat Blondlot's experiments, but with no satisfactory result.

A strange development of the work of research occurred when M. Blondlot published an account of a new sort of N-rays, which, while resembling those already described, had in many cases an inverse effect. They diminished instead of increasing the brilliance of a small electric spark when they fell upon it, and they caused a decrease in the phosphorescence of a sulphide of calcium screen. These rays it was proposed to call N'-Rays. Another property, both of these new rays and the N-rays themselves, was, that they become stored up in substances on which they strike. A brick exposed to the rays of the sun seems to absorb N-rays and give them out afterwards. A curious effect next noticed was that a screen feebly phosphorescing and exposed to the action of the N-rays, when viewed normally by a person straight in front of it, appeared more luminous than before, whilst it became less luminous if looked at very obliquely or almost tangentially.

Further researches were carried out on the transparency of different substances to the N-rays, and they were found to vary very much in this respect. Silver was found to be particularly transparent, and nickel and some other metals opaque to these rays.

The investigations were next taken up by various physiologists, especially M. Augustin Charpentier, of Nancy, who described how stretched muscle gave out N-rays. Phosphorescence was produced on a screen of barium platino-cyanide by means of a salt of radium, and it was found that on bringing up various portions of the human body to the screen the brilliancy of the phosphorescence was increased. Muscle and nerve

especially were observed to produce this effect, and muscle appeared to act more powerfully in proportion as it more strongly contracted. The effect was not due to heating of the screen, which would also tend to increase the phosphorescence, for means were taken to guard against this. M. Charpentier was led to the conclusion that the human body itself emitted N-rays. Further experiments seemed to show that from the frog and other animals N-rays were sent out. The portions of the body rich in nerves especially manifested this peculiar influence, and brightening of the phosphorescent screen was observed when such portions of a living organism were brought up to it. The compression of a nerve noticeably increased its power of vivifying the brightness of a glowing screen. Certain portions of the brain were especially active in giving out N-rays, and these portions could be localised on screens by the increased brightness which they produced. The behaviour of these radiations seemed to vary, and it was thought that the effects were due to rays which differed somewhat amongst themselves. The rays coming from nerve and brain were found to be stopped by a thin sheet of aluminium, while those proceeding from the heart, the diaphragm, and various muscles passed readily through aluminium and manifested their effects beyond the interruption.

Meanwhile M. Blondlot had been continuing his investigations, and various strange results were obtained. On examining still further the effect of compression he found that a large number of different substances acquired through pressure upon them the power of emitting the rays. Pieces of wood, glass, and caoutchouc behaved in this way. During compression they became sources of N-rays and increased the faint phosphorescence of a calcium sulphide screen. They also appeared to act directly on the retina (which is the result of the emission of N-rays), and caused the action of light upon it to be intensified. Thus, when the observer looked upon the face of a clock in a partly darkened room, which was so dimly lit that the clock-face was scarcely visible, and then bent a cane near his eyes, the compression of the cane had such an effect on his retina that the clock-face became clearly visible and the figures could be read.

Compressed glass had the same effect. These phenomena were not instantaneous; time was required for the effects to be observed. Bodies which were in a state of internal constraint were sources of N-rays. Tempered steel, hard-hammered brass, and crystalline sulphur were found to be permanent sources of these rays. A file or a tempered knife-blade acted like the compressed cane in brightening a clock-face in a dark room or in strengthening phosphorescence in a sheet of suitable material already excited. This emission of these mysterious rays apparently lasted for an indefinitely long time. A tempered knife-blade from an ancient Gallo-Roman tomb, as well as other similar ancient objects, behaved just as did a recently-made knife-blade. They emitted rays. The rays thus got in so remarkable a way were analogous to those of light. Spectra could be got, and the rays were capable of reflection, refraction, and polarisation, as are those of light. The energy thus appearing M. Blondlot considered was furnished by the potential energy which corresponds to the state of constraint of tempered steel.

[Our readers are doubtless aware that many experimenters have quite failed to obtain similar results.—ED.]

Flint Implements Found by Accident.

By W. G. CLARKE.

MANY finds of Neolithic flint implements are in the nature of a surprise, as the following instances will suffice to prove. A Methwold farmer walking along the edge of one of his fields was attracted by a gleam of white at the foot of the hedgerow. Investigation disclosed a polished axe, curiously enough the only implement ever found on the farm. In this instance the finder knew what his discovery was, but a labourer at Flegg Burgh, Norfolk, was not so fortunate. He was ploughing and uncovered three axes lying side by side—two of polished white flint and one of chipped black flint. Thinking there was something uncanny about them, he kept the flints for a year to see if they would grow. As they did not, he made inquiries, and eventually found a purchaser. Numerous implements have been found projecting from earthen boundary banks. Such was the case with a fine axe firmly embedded in a roadside bank between Weeting and Brandon, and pulled out by a woodman struck by its unusual shape. Even more curious was an instance which occurred near Thetford. In the footpath leading to a gamekeeper's house there was a white stone, level with the surface and trodden upon by almost every passer-by. One severe winter it became loosened by frost, was kicked up by the gamekeeper stumbling against it, and found to be a white flint axe of the Cissbury type. As an example of a remarkable coincidence the following is noteworthy. Three men were walking over a heath in North-West Suffolk. They were not searching for flint implements, but the two outside men stooped down simultaneously and each picked up a perfect arrow-head. Even more strange is the history of the finding of the finest Neolithic axe yet recorded from East Suffolk. Between Carlton Colville and Kirkley, a railway line only used for goods traffic passes through a cutting. Abutting on this at one time was the playing field of a local school. One day as the boys were playing, a football was kicked into the cutting, and when the headmaster jumped over the fence after it he dislodged a big stone, which rolled down the slope. Its shape attracted attention, and he found that he had unwittingly unearthed a treasure. On one occasion the writer was searching the sides of a pit when suddenly a number of wasps came from a hole. Quickly stepping down the slope he disturbed a glistening piece of flint which proved to be a one-tanged lance-head of most beautiful workmanship. Many good implements have been found on stone-heaps. Some years ago Mr. E. T. Pengelly visited Norwich to give a lecture on Kent's Cavern. Prior to the meeting he had a short ramble, and from a stone-heap near Old Lakenham Church picked up a polished axe. Somewhat similar was the case of a labouring man at West Harling, who noticed a golden-coloured stone on a heap which had been collected from a field. He removed it, and it was seen to be a double-headed axe of yellow flint, magnificently chipped, and so thin as to be almost transparent; in fact, one of the best known English specimens. Numerous other examples could be given, but these are sufficient to prove that all Neolithic flint implements are not found as the result of systematic search, and that an element of chance enters into the discovery of some of the very best examples.

XUM

The "Tele-activity" of Chemical Reactions.

MANY readers of "KNOWLEDGE" will, perhaps, be glad to hear of some research which offers an unlimited field for experiments, and which may also prove to be of some importance in several branches of manufacture.

Resonance in sound is familiar, both in practice and theory, to everyone; wireless telegraphy is an example of electrical resonance; in the former, the effects are produced by vibrations in the air; while, in the latter, the ether is the medium which transmits the disturbances. It does not require a very great effort of imagination to conceive that something similar may take place when waves in the ether are produced by means of a chemical reaction.

With the object of investigating this, several experiments have been proposed and carried out, but the results up to the present have not been very conclusive.

Two substances (mercury and iodine), which combine readily at ordinary temperatures to produce a compound easily recognised, were placed together in an open vessel. A vigorous chemical reaction (sulphuric acid on potassium chlorate and sugar) was allowed to take place very near it, and the mercury and iodine were afterwards compared with a similar mixture which had been prepared at the same time, and kept in another room. The amount of mercuric iodide produced in the protected vessel was much less than in that which had been exposed to the reaction. It was suggested that the heat produced by the reaction would account for the difference, and so the experiment was repeated with an asbestos mat placed over the vessel to shut off the heat, a thermometer being placed with the mercury. The temperature did not rise, but the effect was not as marked as before.

A photographic plate was then exposed to the same reaction (well protected, of course, from light rays), and when developed the image of lines on a piece of paper could be clearly seen. This, perhaps, may be explained in some other way.

It was then decided to determine whether one reaction would accelerate another. Two solutions were prepared containing the same quantities and proportions of sodium thiosulphate and hydrochloric acid. One was removed as before, while the other was exposed to the chlorate reaction. In every case it was observed that sulphur was deposited more quickly in the solution exposed to the reaction. These experiments were repeated, using blank cartridge to produce the disturbance, and very decided results were again obtained.

The strengths and proportions of the solutions were varied considerably:—

H Cl	1 cc. (conc.)	in 25 cc. water, to
	1 cc. ,,	in 50 cc. water.
$Na_2 S_2 O_3$	1 gr.	in 125 cc. water, to
	1 gr.	in 75 cc. water.

Proportions taken—
5, 10, 15 H Cl with 20, 25, 50 $Na_2 S_2 O_3$.

Similar experiments were tried, using hydrogen peroxide and potassium iodide (with a little starch to show separation of iodine). The effect of the explosion was always to cause a sudden coloration of the solution, while an exactly similar solution prepared at the same time, but not exposed to the explosion, did not change colour until several minutes later.

About a week afterwards, these experiments were repeated; the results observed were similar to, but not as decisive as, those mentioned above.

The effect of the explosion of nitrogen iodide on a mixture of hydrochloric acid and sodium thiosulphate solutions, using same strengths as before in proportion of 10 to 50 cc., was a scarcely perceptible difference in the rates of deposition. When the proportions were altered to 13 to 50 cc., the difference was very decided.

The above results were thought to be due to the shaking produced by the explosion, but it was found that there was no difference in the rates of deposition of the sulphur, if one were shaken mechanically, and the other not.

Both chemical combination and decomposition have been employed to affect another reaction at a distance, but in all cases the results, when critically examined, were hardly decided enough to warrant the assertion that one chemical reaction can be influenced by another when there is no apparent communication between them. An accident, however, showed that this was at least possible. A large quantity of the chlorate and sugar mixture had been made up in proportion not noted. A little of this was placed in a basin, and while the rest of the mixture was held behind the operator, in a large mortar, strong sulphuric acid was added to the former, causing it to ignite in the usual way. Immediately afterwards, the rest of the mixture blazed up, although it was impossible that sulphuric acid could have got to it.

Similar mixtures in a great number of different proportions have been prepared and tried, but up to the present the exact proportions necessary for a repetition of the above phenomenon have not been ascertained.

It was thought that the desired result might, perhaps, be obtained if the two mixtures were connected in some way—by a wire or piece of glass tubing—but these methods have given no results. The experiments have been tried using similar and dissimilar substances:—Chlorate and sugar on a similar mixture; nitrogen iodide on nitrogen iodide; chlorate and sugar on a mixture of these substances, but in different proportions; chlorate and sugar with nitrogen iodide; also strong sulphuric acid and water, strong acids and solid caustic soda have been used as primary reactions, molecular proportions always being employed. When solid substances are used, the effects are not obtained, probably because the substances or proportions are not "in tune"; while when liquids are used a certain amount of action is observed, but the greatest possible effects are not produced.

One other experiment awaits a satisfactory explanation: Some nitrogen iodide had been prepared and kept for nearly a month suspended in a solution of ammonia. The day on which its services were required had been devoted to a large number of experiments with potassium chlorate and sugar. The ammoniacal nitrogen iodide solution was carried across the laboratory, with the object of being filtered and dried, and placed on the bench where the above experiments had just been carried out. It had only been there five seconds at the most, when it exploded with its customary violence.

Of course it may be only a coincidence—even then, the object of the investigation is to explain these "coincidences"—or it may be that a violent chemical reaction converts the space in its immediate vicinity into a medium that will accelerate or even induce chemical activity. This latter does not appear an impossible ex-

XUM

planation, and it should be thoroughly investigated before being rejected.

If it be true that one reaction does influence another, the importance of the investigation cannot be overestimated. The preparations and violent reactions that go on from day to day in a laboratory may be altering (and those accustomed to manage a chemical laboratory know how certain substances do unaccountably alter) the molecular arrangement of the substances in the neighbourhood of the demonstation benches.

This, moreover, raises the question: "Does the weather influence the communication between one chemical reaction and another?" As has been stated above, it was observed that the results of the experiments varied (in degree) from day to day.

A thorough investigation of this subject may shed a new and more satisfactory light on the cause of intramolecular action.

Among the few experiments described above, there may be some that will suggest others which will lead to more decided and consistent results, so that if it be possible to control chemical reactions at a distance, further research would show how it can be most efficiently demonstrated.

A. F. B.
B. I.

Practical Meteorology.

II.—Rainfall.

By WILLIAM MARRIOTT, F.R.MET.SOC.

IN the present article it is proposed to deal only with the rain after it has reached the earth. In the term "rainfall" is included rain, snow, hail, dew, mist, &c. The rainfall is always expressed in inches, and is supposed to represent the height to which the rain would rise on the level ground if none of the water were permitted to run off or percolate through the soil, or to evaporate.

The instrument used for measuring the rainfall is called a rain gauge. This is best made of copper, and should have a circular funnel of five or eight inches diameter. It is very desirable that it should be of the Snowdon pattern, which has a deep rim to retain snow (Fig. 1). The gauge should be placed in an open and well-exposed situation free from trees, walls, and buildings; and should be firmly fixed so that it cannot be blown over. The top of the funnel should be one foot above the ground, and be quite level. The measurement of the rain is effected by pouring out the contents of the can or bottle into the glass measure and reading off the division to which the water rises. The gauge must be examined daily. When snow falls, that which is collected in the funnel is to be melted by adding a known quantity of warm water, and entering the difference as rain.

Rain gauges should not be placed on walls or roofs, as the buildings themselves offer obstructions to the wind which carries the rain drops over the funnel and so gauges mounted in such positions collect less rain than those placed on the ground. This was demonstrated as far back as 1766, for in that year Dr. W. Heberden, F.R.S., had three rain gauges at work at Westminster—one on the roof of the dwarf tower of the Abbey, one on the roof of a house close by, and another in the garden of the same house. The amounts of rain collected by these gauges were:—

Tower of Westminster Abbey ..	12·10 inches
Roof of house	18·14 ,,
Garden	22·61 ,,

These differences were due almost entirely to the action of the wind.

Through the influence of Mr. G. J. Symons it was agreed some years ago to adopt 9 a.m. as the hour at which the rainfall should be measured each day, and the amount entered to the *previous* day. There had been much diversity in this matter, observers measuring the rain at various hours, *e.g.*, 8 a.m., 9 a.m., 10 a.m., noon, 3 p.m., and even midnight. As there are now nearly 4,000 observers in the British Isles, 9 a.m. is evidently the most convenient hour to the vast majority, and its adoption has secured uniformity in the measurement of rainfall.

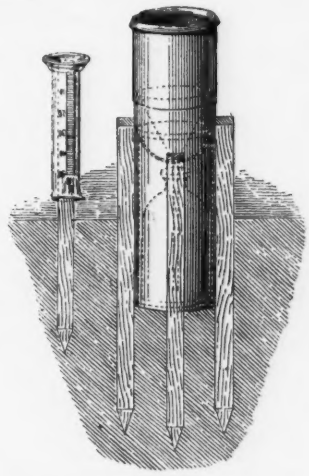


Fig. 1.—Snowdon Pattern Rain Gauge.

In hilly and mountainous districts, and in places where it is not possible to visit the rain gauge daily, the contents of the gauges should be measured monthly, the morning of the 1st of the following month being chosen for the purpose. These mountain gauges must be of sufficiently large capacity to contain the month's rainfall.

As everyone knows, the rainfall is very irregular, but, as a rule, there is most rain in the autumn and winter, and least in the spring. The following figures give the average monthly rainfall at the Royal Observatory, Greenwich, for the 89 years, 1815-1903:—

January ..	1·80 ins.	July ..	2·45 ins.
February ..	1·52 ,,	August ..	2·33 ,,
March ..	1·52 ,,	September	2·25 ,,
April ..	1·61 ,,	October ..	2·72 ,,
May ..	1·95 ,,	November ..	2·29 ,,
June ..	1·97 ,,	December ..	1·95 ,,

Total for the year .. 24·36 ins.

It will thus be seen (Fig. 2) that October is the wettest month with 2.72 ins., and that February and March are the driest months with 1.52 ins. each. Although the above values represent the average rainfall, the individual monthly falls are often greatly different. For instance, with regard to the month of October, the fall in 1834 was only 0.47 in., whilst in 1880 the fall was as much as 7.65 ins. Again, with

regard to the month of February, in 1821 the fall was 0.04 in., whilst in 1866 the fall was 4.03 ins.

Owing to the great variability in the rainfall, it is very desirable that the averages should be based upon as long a period as possible; most of the recognised authorities on the subject assert that the period should not be less than 30 years.

Meteorologists in particular, and the people of the British Isles in general, owe a deep debt of gratitude to the late Mr. G. J. Symons, F.R.S., for having commenced the collection of rainfall statistics in 1860, and for publishing the results yearly in the volumes of *British Rainfall*. The number of stations at the time of his death, in 1900, was over 3,400. He not only collected these statistics, but he also secured uniformity in the measurement of the rainfall and in the exposure of the gauges, and he thoroughly checked the accuracy of the returns sent to him. It is satisfactory to know that the work is still being carried on under the able supervision of Dr. H. R. Mill.

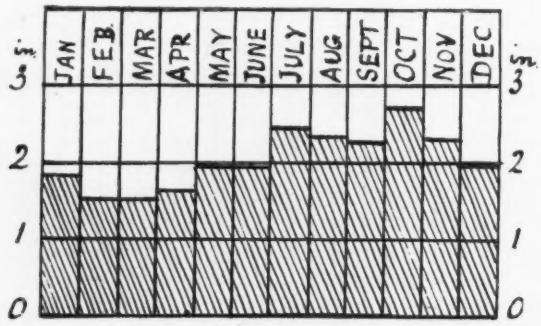


Fig. 2.—Average Monthly Rainfall at Greenwich.

From the rainfall maps of the British Isles compiled by Mr. Symons, Dr. Buchan, and Dr. Mill, it is seen that the average annual rainfall exceeds 40 inches along the western coasts, and that in several districts it exceeds 75 inches, chiefly the west Highlands of Scotland, the English Lake District, and the Snowdonian District of North Wales. Over the eastern part of Ireland and of Scotland, and the south of England, the rainfall is mostly between 30 and 40 inches, while over the eastern counties of England it is less than 25 inches.

The average annual rainfall of England is about 32 inches, of Wales 49 inches, of Scotland 47 inches, of Ireland 42 inches, and of the British Isles as a whole 39.5 inches.

At Seathwaite, in Borrowdale, Cumberland, the average annual rainfall reaches the large amount of 135.49 inches; while about a mile further away on the shoulder of the hill, near Stye Head, the average rainfall is 175 inches.

The average monthly rainfall at Seathwaite is as follows:—

January ..	15·51 ins.	July	9·21 ins.
February ..	12·03 ,,	August ..	11·52 ,,
March ..	10 35 ,,	September..	11·80 ,,
April ..	6·99 ,,	October ..	14·06 ,,
May ..	6·84 ,,	November..	13·82 ,,
June ..	7·49 ,,	December ..	15·87 ,,

The prevailing winds over the British Isles are mostly from the south-west. These come off the Atlantic warm and highly charged with moisture; and as they strike against the hills in the west, the moisture is condensed and falls as rain. Thus the heaviest rainfall occurs in the west, and the amount increases according to altitude.

A few years ago the author discussed the average rainfall for the 10 years 1881-1890, at 309 stations in England and Wales, grouping the stations according to altitude above sea-level. The results for each hundred feet were as follows:—

Altitude	100 ft.	..	Rainfall	27·69 ins.
,,	200 ,,	..	,,	30·50 ,,
,,	300 ,,	..	,,	31·49 ,,
,,	400 ,,	..	,,	32·49 ,,
,,	500 ,,	..	,,	40·64* ,,
,,	600 ,,	..	,,	37·38 ,,
,,	700 ,,	..	,,	39·01 ,,

These results show clearly an increase of rainfall with altitude.

Wishing to confirm the statement already made that the heaviest rainfall occurs on the west coast, &c., the author subdivided the above stations into western and eastern—considering those as "western" which drained towards the west, and those as "eastern" which drained towards the east. The following interesting results were obtained:—

			West.	East.
Altitude	100 ft. ..	Rainfall	33·15 ins.	24·82 ins.
,,	200 ,, ..	,,	35·87 ,,	25·94 ,,
,,	300 ,, ..	,,	35·72 ,,	26.89 ,,
,,	400 ,, ...	,,	39·56 ,,	28·45 ,,
,,	500 ,, ..	,,	46·08* ,,	29·87 ,,
,,	600 ,, ..	,,	38 08 ,,	35·84 ,,
,,	700 ,, ..	,,	41·25 ,,	35·27 ,,

These values show in a very striking manner that the rainfall is considerably greater in the west than in the east, the excess being nearly a quarter. If the stations had been more numerous, and if the observations had extended over a longer period, there is no doubt that the results would have been more uniform.

The place which has the heaviest known rainfall in the world is Cherrapunji, an Indian station situated in the south-west of Assam, on a small plateau forming the summit of one of the spurs of the Khasia hills. The hill on which Cherrapunji is situated rises precipitously about 4,000 feet from the lowlands of Cachar and Sylhet, which are barely 100 feet above sea-level. The south-west monsoon, advancing from the Bay of Bengal, sweeps over these low lands, and, meeting the hills, is suddenly deflected upward. Rapid condensation takes place and heavy rain falls. The average annual rainfall at Cherrapunji is about 500 inches, which fall mostly between April and September. In the month of August, 1841, the rainfall amounted to 264 inches. The heaviest rainfall in one day was 40.8 inches on June 14th, 1876.

The extremes in this country appear very insignificant compared with the amount just named, nevertheless they are often considerable. For instance, on August 6th, 1857, the observer at Scarborough measured 9½ inches, but the rainfall actually exceeded that amount, as the gauge had overflowed. At Seathwaite 8.03 inches fell on November 12th, 1897. On July 14th, 1875, more than 5 inches fell over Monmouthshire. On June 23rd, 1878, Mr. Symons, at Camden Square, London, recorded a fall of 3¾ inches in an hour and a half.

It is these exceptionally heavy rainfalls which are so serious and which do such an amount of damage. It is, therefore, necessary for engineers and surveyors to know something of the rate at which rain may be

*These values are largely increased by the heavy rainfall at Seathwaite.

expected to fall, in order that they may be able to provide adequate means for the storm-water being carried away without causing floods. For this purpose self-recording rain gauges are of great value. These might with advantage be also used by other observers with whom "money is no object."

Fig. 3 is a copy of the trace by the self-recording rain gauge at the Fernley Observatory, Southport, which shows the heavy rainfall which occurred on September 10th, 1903, during the meeting of the British Association in that town.

Thunderstorm rains are often very heavy, but are mostly of a local character; they are also occasionally accompanied by hail. The hailstones usually take the form of little pellets or balls, and consist of compacted ice and snow. During the exceptionally violent thunderstorms which occurred at Harrogate and at Richmond, in Yorkshire, on July 8th, 1893, hailstones and March 10th, 1855, some of which are reproduced in Fig. 4.

Snow is much less dense than rain. A foot of snow is, *roughly*, equal to an inch of rain. Snow, however, varies greatly in density; with very dense snow, seven inches may equal one inch of rain, while with very light snow as much as sixteen inches may equal only one inch of rain.

A "rainy day" in this country is that on which a hundredth of an inch (.01 in.) of rain has been measured. The average number of rainy days in the year at the Royal Observatory, Greenwich, is 157; these are distributed over the months as follows:—

January	...	15	July	...	13
February	...	12	August	...	13
March	...	13	September	...	12
April	...	12	October	...	15
May	...	12	November	...	14
June	...	12	December	...	14

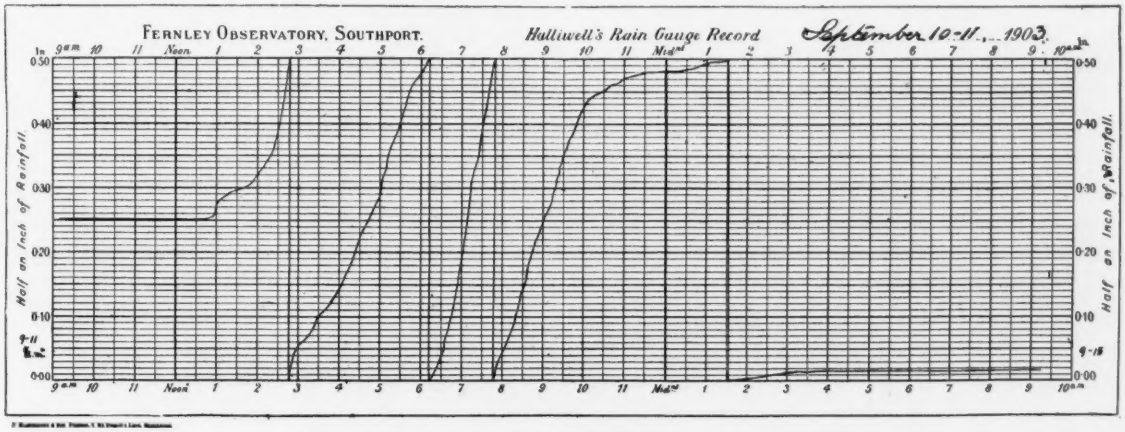

FERNLEY OBSERVATORY, SOUTHPORT.
Hallitwell's Rain Gauge Record
September 10-11, 1903.
Half an inch of Rainfall
Half an inch of Rainfall.

Fig. 3.—Record of Heavy Rainfall at Southport, September 10-11, 1903.

from 2 to 3 inches in diameter fell, and caused great destruction of property. These hailstones had several alternate coatings of opaque and clear ice. These coatings were no doubt due to the revolutions accomplished by the hailstones, which were probably several times drawn in towards the vortex of the storm.

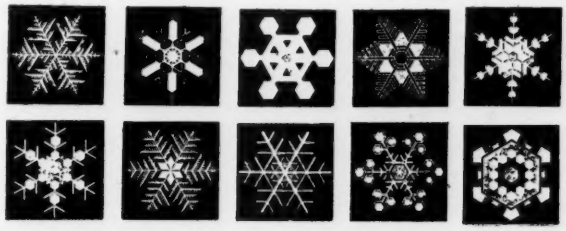


Fig. 4.—Snow Crystals, by Glaisher.

When the aqueous vapour in the air is condensed at a temperature below the freezing point it freezes and falls in the crystalline form of snow. Snow crystals are six-pointed stars, and are of great variety. The late Mr. J. Glaisher, F.R.S., observed nearly 200 different varieties of snow crystals between February 8th

From a long continued series of rainfall records it is readily seen that there is a considerable variation in the annual amounts. The London records of rainfall show that from 1730 to 1750 there was a succession of dry years, and most of the readers of "KNOWLEDGE" will remember that there was also a succession of dry years (with three exceptions) from 1883 to 1902. The periods of successive wet years have been somewhat shorter than those of dry years.

With regard to the limits of fluctuation in the total rainfall, Mr. Symons arrived at the following conclusions:—1. The wettest year will have a rainfall nearly half as much again as the average. 2. The driest year will have one-third less than the average. 3. The driest two consecutive years will each have one-quarter less than the average. 4. The driest three consecutive years will each have one-fifth less than the average.

These conclusions are of the greatest importance to engineers when considering the question of water supply, for if provision is not made for "the driest three consecutive years," the result will most likely be a "water famine." There are many interesting subjects connected with rainfall, such as the influence of sunspots, periodicity, cycles of rainfall, &c., but these have not been discussed, as they are outside the scope of the present paper.

XUM

Star Map.—No. 4.

Perseus, Auriga, and Taurus.

THE portion of the heavens here represented is one full of interest. In addition to the three well-known constellations named, we have the greater part of Orion, which forms one of the most conspicuous and easily recognised of all the constellations, as well as Gemini (the greater part of which has appeared in Map No. 6).

Orion is one of the useful star figures by which one's position is readily ascertained. The three stars forming the head are due north of the centre of the belt. The sword depending from the belt is an appropriate sign of the N. and S. line †.

The Great Nebulæ of Orion, situated in the centre of the sword, is certainly one of the most remarkable objects in the heavens. This nebulæ, visible to the naked eye, and presenting a wonderful appearance on the photographic plate, seems to be but the centre of a huge spiral which extends faintly on all sides to the limits of the constellation.

There are a number of conspicuous stars in this part of the sky.

θ Persei (II. h. 37 m. + 48° 49′) is a triple star, of which two, A and B, are probably binaries, while C at a distance of 80″ does not share the same proper motion, and is, therefore, probably independent.

β Persei (*Algol*) (III. h. 2 m. + 40° 35′). This star has long been known as an extraordinary variable, hence called *El Goul*, "the demon." It has a regular period of variability. After being for 2 days 21 hours of 2·2 magnitude, it rapidly declines, until in just over four hours it is only 3·7 magnitude, after which it increases again in about the same time to its original magnitude. It is now practically certain that this change is caused by the interposition of a large dark body revolving around the brighter one, the orbit of which happens to be in a plane which passes through our earth. The two stars are probably very close together, and of much the same size. On September 3 it is at its minimum at 4 h. 42 m. a.m., from which time the other phases can be calculated.

The Pleiades (III. h. 41 m. + 23° 48′). This well-known cluster contains six stars visible to the naked eye. As most of them have a common proper motion, they doubtless form a system. A nebulosity surrounds all the principal stars. The length from Atlas to Celæno is 1° 6′. Those who have not considered the matter are often surprised to hear that this little group covers an apparent area much greater than that of the Full Moon (the mean diameter of which is 31′), and a representation to scale is therefore appended.

α Tauri (*Aldebaran*) (IV. h. 30 m. + 16° 19′). Magnitude, 1·1. Near this is the group known as the "Hyades."

On September 19 the Moon will pass across the region of the Hyades and Aldebaran. (Vide p. 236.)

α Aurigæ (*Capella*) (V. h. 9 m. + 45° 54′). Magnitude, 0·2.

β Orionis (*Rigel*) (V. h. 10 m. − 8° 19′). Magnitude, 0·3.

Nebula M. 1. Tauri (V. h. 29 m. + 21° 57′). Known as the "Crab."

θ Orionis (V. h. 29 m. − 5° 28′). A multiple star situated in the Great Nebula of Orion. Four principal stars are of magnitudes 6, 7, 7½, and 8.

σ Orionis (V. h. 34 m. − 2° 39′). A multiple, composed of two sets of treble stars.

ζ Orionis (V. h. 36 m. − 2° 0′). A double star, magnitudes 2 and 6, with a faint companion 57″ distant of 10th magnitude.

α Orionis (*Betelguese*) (V. h. 50 m. + 7° 23′). A yellowish-red star, 1st magnitude. Variable to a slight extent.

β Aurigæ (*Menkalinan*) (V. h. 52 m. + 44° 56′). A spectroscopic binary, proving it to consist of two equally bright stars revolving in a period of 4 days.

The Great South Tropical Spot on Jupiter.

ONE of the most interesting and prominent features of Jupiter during the last four years has been a dark shading spreading more or less over the south tropical zone. It has been visible since the spring of 1901, and has maintained so striking an aspect, albeit a changeable one, that it promises to offer a parallel with the red spot and its surroundings as regards permanency.

Though situated in the south tropical zone of the planet its motion accords with that of the south temperate current which is about 9 h. 55 m. 19 s. from a mean of many spots seen at Bristol in recent years.

Between June 18th, 1901, and August 7th, 1905, the spot completed 3,655 rotations, with a mean period of 9 h. 55 m. 18.9 s., and it lost 16°.2 of longitude per month relatively to system II. (based on a rate of 9 h. 55 m. 40.63 s.) of Crommelin's ephemerides. The motion appears to have become gradually slower with the time, the rotation period having been about 9 h. 55 m. 18.5 s. in 1901, whereas it was about 9 h. 55 m. 19.5 s. in 1905.

In 1903 the average length of the spot was 48°, but when passing the red spot in July, 1902, it was about 87° long. I obtained an observation of the object on August 7th, 1905, as under :—

	H. M.	Longitude. °
P. end on C.M.	15 53	157·9
Middle ,, ...	16 28	179·1
F. end ,, ...	17 5	201·4

So the length on that occasion was = 43°.5. I used a 12½-in. Calver reflector, powers 300 and 440, but the latter was rather too high for the state of the air.

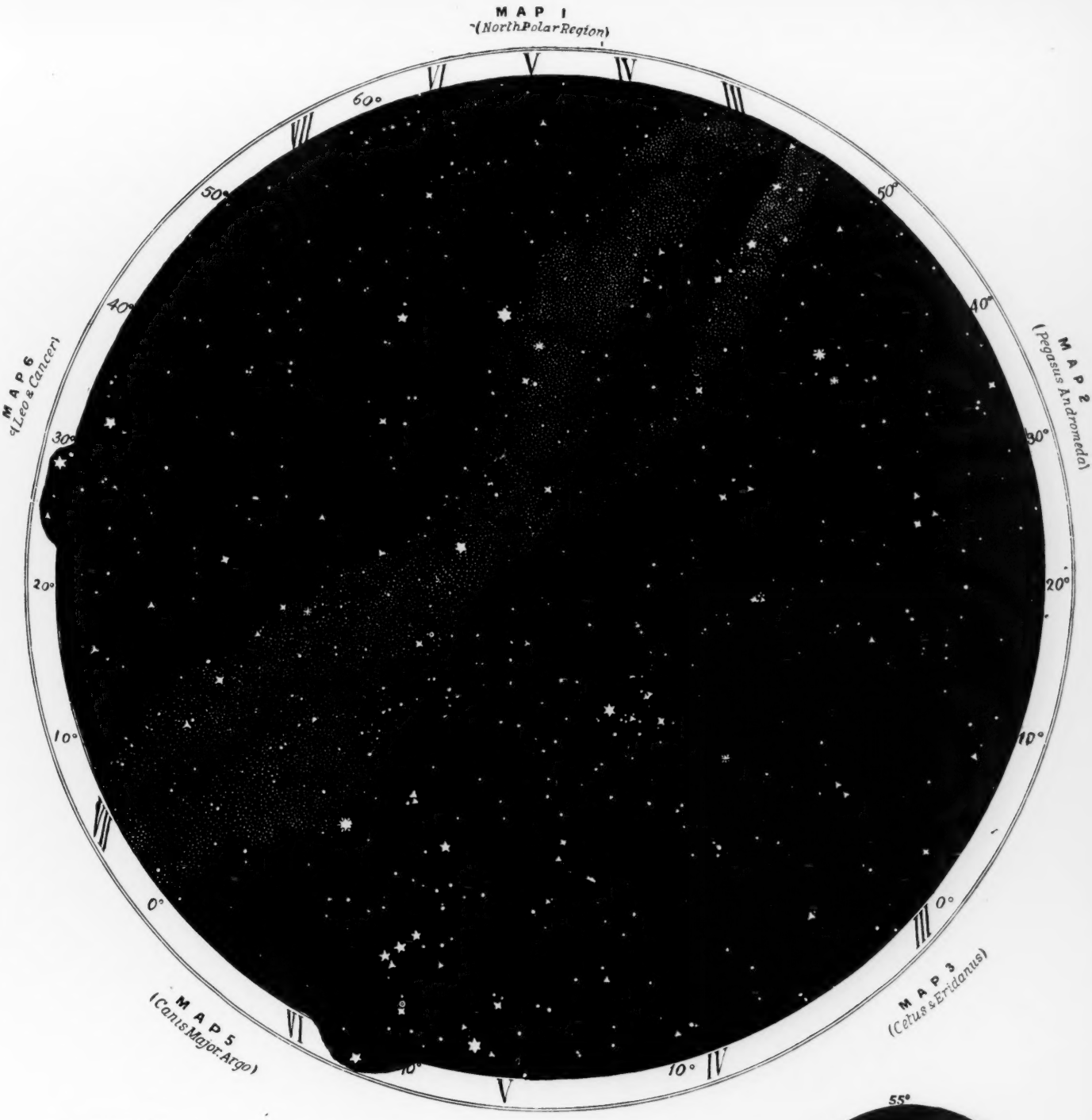
The durableness of this marking, its conspicuous appearance, and the fact that it has apparently influenced the very irregular motion of the red spot in and since 1901, render it a peculiarly important and attractive object for telescopic observers. It should be looked for in the following longitudes during the next two years :—

Date.				Longitude.
1905.	September	15	.. .. ..	158·8
,,	October	15	.. .. ..	142·6
,,	November	15	.. .. ..	126·4
,,	December	15	.. .. ..	110·2
1906.	January	15	.. .. ..	94·0
,,	February	15	.. .. ..	77·8
,,	April	15	.. .. ..	45·4
,,	August	15	.. .. ..	340·6
,,	October	15	.. .. ..	308·2
,,	December	15	.. .. ..	275·8
1907.	February	15	.. .. ..	243·4
,,	April	15	.. .. ..	211·0
,,	September	15	.. .. ..	130·0

W. F. DENNING.

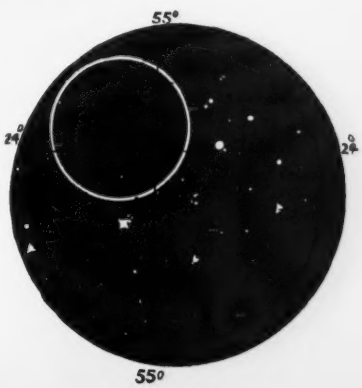
Bristol, August 8, 1905.

MAP No. 4.



BRIGHTNESS.

- 1st Mag.
- 2nd ,,
- 3rd ,,
- 4th ,,
- 5th ,,
- 6th ,,
- Variable.
- Nebula.



The Pleiades.

MAP No. 4.

Perseus, Auriga, and Taurus.

XUM

Seaweeds:

A Holiday Paper for Field Botanists.

By DAVID W. BEVAN, Scarborough F.N. Society.

II.—The Red Seaweeds.

IF the brown seaweeds are the giants of the shore, the red are the fairies. These little plants show an almost endless variety of form, but they are all really very much alike in build. Like all other lowly plants, the seaweeds are built up entirely of *cells*, and it is simply the grouping of these cells, and their way of dividing,

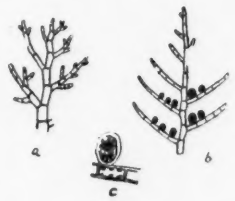


Fig. 1.

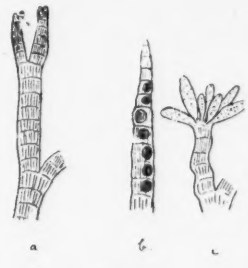


Fig. 2.

that determine the shape and appearance of the red seaweeds.

We have only time to glance at a few of those that are pretty sure to turn up. One of the loveliest little things for the microscope is *Callithamnion roseum* (Fig. 1—*a*). It is unfortunate that these little beauties have no "common" name. The botanical name means, in plain English, "The bonny bush of rosy hue." It is a simple row of oblong cells, with branches of the same pattern coming off right and left alternately, each cell of the branch again bearing a branch:—a bonny little plant, only about half an inch high, at most, growing often on the bare rock. Each cell contains a number of round, red bodies, corresponding to the chlorophyll

Fig. 3.

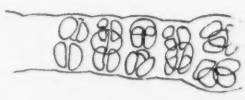


Fig. 4.

corpuscles of the land plants. Similarly, the brown seaweeds are brown because their colour-bodies are brown. But they all contain chlorophyll. Put bits of a red and a brown seaweed in alcohol for a few minutes; these colours are dissolved out, and the surprising fact appears that the brown seaweeds, and the red, are as green as grass.

Another *Callithamnion* (*floridulum*) entangles mud and sand in its branches, forming dense, dark red cushions up to two inches in thickness. As you wend your way over these cushions, you would scarcely suspect you were treading on a plant. On tearing the cushion open, we find the plant is dead below, but ever growing at the top—like the bog moss.

The most delicate seaweed known to the writer, and a pretty object for the microscope, is *Bangia*, a single, unbranched filament of extreme delicacy. It grows in the most reposed situations that are daily hammered by the waves. How it survives—and winter is its most flourishing time—is a mystery. Though it begins life as a single row of cells, a transverse section taken at maturity would pass through four cells, and these divide again to produce spores. Fig. 4 is a highly magnified view of a portion of a filament, the outlines only of the cells being shown.

The *Polysiphonias* (Fig. 2), with their long cells arranged like the staves of a barrel, and the *Ceramiums*, with their pretty forked and often curved tips, are very common; and they are all very beautiful under the microscope.

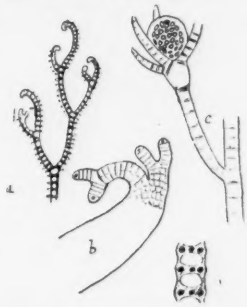


Fig. 5.

Fig. 6.

The commonest Polysiphonia, and one which is sure to be met with, grows in bushy tassels on the Knotted Wrack and it is as pretty as any of them. They all divide dichotomously, and can be recognised by the lens, as each "internode" of the filament has one large, central cell, and a number (varying in different species) of long, narrow red cells, arranged round it (see Fig.

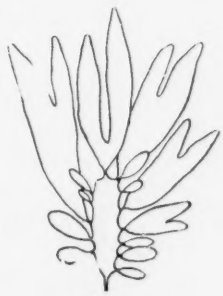


Fig. 7.

Fig. 8.

3—*a*, which is a part of Fig. 2—*a*, more highly magnified). The Ceramiums are also dichotomous, and have, as a rule, curled tips. The naked eye shows they are made up of alternate light and dark coloured segments. While all are charming, words fail to describe the exquisite beauty of the Bristly Ceramium (C. ciliatum), when a small snipping is examined under either low or high power (Fig. 5—*a*). It grows at Scarborough on the front face of the limestone platform of the White Nab—a tiny plant only about one-third of an inch high—along with a little Polysiphonia with only four "staves" to its "barrel." This little Ceramium is easily known by its strongly-incurved tips, and by the colourless hairs growing on its frond. One's first impulse, on seeing this little beauty, is to call one's friends and neighbours together to share one's joy.

XUM

Fig. 5—*b* is a view of the very tip of a Ceramium frond, showing the regular method of cell division.

Other red seaweeds show their beauty without the aid of the microscope. Among them are the *Ptilota*, a splendid feathery plant, growing on stalks of the big Tangles, and the Mermaid's Comb (*Plocamium*), happiest below low-water mark, and easily recognised, because the frond bears branches on one side only, like the teeth of a comb, and these repeat the process. Fig. 11 shows a snipping of the frond enlarged. Others are *Chilocladia*, with sprays like branching rows of eggs, or beads, Corallines, with a white skeleton of carbonate of lime—formerly believed to be an animal allied to the corals—and the broad, leafy forms in great variety, from Porphyra, a flat sheet of cells, several inches across, lying flat and *black* on the rocks when the tide is out; Irish Moss (Chondrus), with a flat dichotomous frond, often rather curly; and a host of

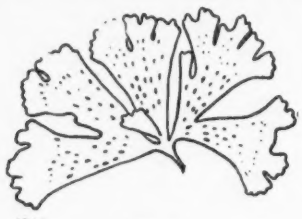


Fig. 9.

others, till we reach the Rhodymenias, with frond of various patterns, and the Delesserias, with leaves exactly like those of land plants—midrib, veins, and all complete. Fig. 6 is part of a frond of *R. laciniata*, natural size; Fig. 7 is *R. palmata*, half size, and Fig. 8 is *D. sanguinea*, natural size.

The Irish Moss is one of the few seaweeds that are put to any use. It is still gathered, washed in fresh water, and dried, and in this state sold by the chemist for making jelly. The reader with a turn for experiment will be able to test its "virtues" for himself. We must not omit to mention, however, that the wracks are also useful to man. They are still largely

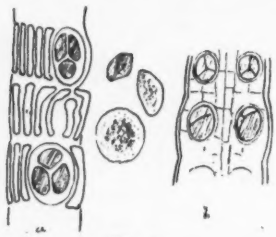


Fig. 10.

Fig. 11.

used for making washing soda. The dried wrack is burnt, and the ash (known as "kelp") is thrown into water, when the soda dissolves, and can be easily crystallised out. (Another easy experiment for the enthusiast, best *not* performed in your seaside lodgings, as the special perfume produced in the burning does not commend itself to many.)

Burning reminds us of drying, and drying reminds us that the visitor to the seaside may wish to take dried specimens home. There are two difficulties to surmount in drying seaweed. The first is the salt in them, which is got rid of by a good soaking in *fresh* water. The second is the gelatinous nature of the frond of many of them, which causes them to stick to the drying paper. To prevent this, put between the seaweed and the paper a clean linen rag—old handkerchiefs are as good as anything else for the purpose. The stickiness of so many seaweeds can, however, be made use of, for if you take the paper on which you intend to finally mount the plant, and slip it into the bowl of water under the seaweed, you can then gently raise the paper with one hand, and with the other spread out the whole plant as it floats upon the paper. The most delicate plants can be easily mounted in this way. Now cover with rag and dry between drying papers. The plant will adhere firmly to its mount, while the linen prevents it adhering to the drying paper.

In searching for red seaweeds, it is well to look out for fruiting specimens. The process by which the egg cells are fertilised in the red seaweeds is very much more difficult to follow than in the brown seaweeds, but the result—the fruit—can, in many cases, be seen with the naked eye. It is sure to be found in summer on some of the Ceramiums (Fig. 5—*c*) and Polysiphonias, and when it is found on that fine plant *Ptilota* (a plant growing on the stalks of Tangles), it forms a very fine microscopic object. Fig. 2—*c* is a snipping of Polysiphonia with the male organs (antheridia).

The red seaweeds, however, have two strings to their bow. They produce not only fruit, by the union of male and female elements, but *spores*, without the need of such union. These always come in groups of four, and are hence called *tetraspores*. When these tiny spores are set free, they develop into new plants. Some plants have them outside, either sessile or growing on short stalks, while others have them inside, buried in the frond. They are easily seen with a lens, and better with the microscope. Callithamnion (the 'bonny bush" mentioned above) is a beautiful object when it bears spores (Fig. 1—*b*, *c*). So is Nitophyllum, a pretty common plant with a broad flat frond. It shows on its surface distinct spots where the buried tetraspores occur. . . . (Fig. 9). A spore-bearing tuft of *Rhodomela*, about $\frac{1}{16}$ inch long, is shown enlarged in Fig. 3—*b*; and a small portion of it is again magnified in Fig. 10—*b*, where the dark spots are seen to be groups of spores, four in a group, but only three visible. These figures may be compared with those of *Polysiphonia* (Figs. 2—*b* and 10—*a*), in the last of which one of the barrel-shaped segments has burst and discharged the spores. Fig. 5—*d* is a bit of a *Ceramium* frond with tetraspores.

The red seaweeds appeal to the most cursory wanderer on the rocks, on account of their numerous and varied forms, and their obvious beauty. But the fortunate possessor of a microscope will soon find a wealth of hidden beauty in them which will much more than fulfil any expectations which this short article may have aroused.

It remains to say a few words about the Green Seaweeds, which have charms all their own, and these will form the subject of the third and last article.

The Word "Patent."

WITH reference to a letter appearing in our July number, "W." writes to ask if the word "Patent" is not merely a condensation of "Pattern entered." It is *not*, being derived from the Latin *pateo*, "to open," Letters patent being "open to the perusal of all." Pattern is derived from the French *patron*, an original model to be copied.

NOTES.

ASTRONOMICAL.

By CHARLES P. BUTLER, A.R.C.Sc. (Lond.), F.R.P.S.

Star Streams.

THE *Times* correspondent with the British Association telegraphs from Cape Town on August 17th:—"In the mathematical section the most important contribution was made by Professor Kapteyn, Director of the Astronomical Laboratory of the University of Groningen, Holland, who read a paper entitled 'On Star Streaming.' Professor Kapteyn explained that he had been working for many years in making investigations into the structure of the stellar universe, and he had arrived at the remarkable conclusion that the proper motions of the stars are not distributed at random in space, but that a great part of the brighter stars belong to one or other of two great streams of stars moving in the plane of the Milky Way and meeting one another in space. This discovery opened up so many questions of the greatest interest that he had asked some of the most important observatories in the world to co-operate in several lines of research which must be carried through before the problem could be completely solved. Professor Kapteyn stated that he required in particular the determination by the spectroscope of the motion in line of sight of a great number of stars down to the eighth magnitude, and he hoped that the Royal Observatory would furnish him with much precious material of this kind."

Algol Variables.

On the 18th he reports: "In the Mathematical Section something of the nature of a sensation was created by a remarkable paper by Mr. Jeans, of Trinity College, Cambridge, on the theory of argol (? Algol) variables, which excited the enthusiastic interest of Professor Darwin, Sir David Gill, and other astronomers.

Recent Observations of Jupiter's Sixth Satellite.

In a telegraphic despatch from the Lick Observatory it is stated that Professor Albrecht has observed the new sixth satellite of Jupiter with the Crossley reflector, the following being the determined positions:—

G.M.T.	Position Angle.	Distance.
1905.—July 25·95	55°·0	25″·1
,, 26·97	52°·7	24″·3
,, 27·93	50°·7	23″·6

The North Polar Cap of Mars.

From November, 1904, to May, 1905, Mr. Lampland was successful in obtaining a big series of determinations of the various features of the north polar cap of Mars. In a summary of the results tabulated, he gives the various aspects presented on various dates during the above period. On January 13, 1905, the cap was shrouded by an extensive veil of dull white; this was eventually pierced by the cap, showing as a brilliant spot about 4° in diameter, and then as a contoured patch some 9°·7 across. The veil was of the same nature as had been obscuring the cap since October 30, and appeared to consist of haze or cloud. From this time onwards many measures of the diameter of the polar cap are given.

On January 19, subsidiary snow patches began to appear from under the veil.

During April no signs of the surrounding white collar were visible, and from a close study of the epochs of its appearance and disappearance, it is thought that it may be something like a spring mist, surrounding the cap during the hotter months of its melting, and this view is supported by the feature of its indefinite boundary. The snow cap proper is girdled during its contraction by a blue belt, due undoubtedly to the material formed by its melting, which can be none other than water from among all the substances we know, whilst the collar lost itself unedged in the surrounding ochre, thus exhibiting the indefiniteness of cloud.

When the white collar disappeared, subsidiary outlying snow patches stood revealed, flanking the true cap about. Of these, the first to show was the great patch in longitude 206°. This was first seen by Schiaparelli in 1888; it was independently discovered at Flagstaff in 1901, and re-observed there in 1903 and 1905.

In 1905, the next most prominent subsidiary patch lay in longitude $\pm$°10, just east of the Mare Acidalium, and a third set was found in about longitude 311°.

Proposed Magnetic Survey of the North Pacific Ocean.

The rapid development of commercial activity in the Pacific region during recent years has rendered necessary the institution of a definite scheme for determining more reliable values of the magnetic elements for those navigating these waters. Except for data from occasional special expeditions, and such as were acquired in wooden vessels many years ago, the present magnetic charts in use depend largely upon observations made on islands and along the coasts. It is evident, however, that such determinations are rarely representative of the true values on account of prevalent local disturbances.

The present plan is to be started under the patronage of the Carnegie Institution, from which an initial allotment of £5000 has been obtained to cover expenses during 1905. The scheme provides for the chartering of a wood-built, non-magnetic sailing vessel of about 600 tons, which, after starting from San Francisco, will pursue a clockwise spiral course, embracing the entire North Pacific Ocean. The total length of the proposed cruise is about 70,000 knots, and it is estimated that the work will occupy about three years.

It is fortunate that the region under consideration contains magnetic observatories in sufficient number and proper distribution for furnishing the necessary corrections to be applied to the observed magnetic elements in order to reduce them to a common epoch. For this purpose, continuous records of the magnetic variations will be available from Sitka (Alaska), Mexico, Honolulu (Hawaiian Islands), Manila (Philippines), Shanghai (China), Tokio (Japan). In addition, it is hoped that a station will soon be started in California, and that the German Government will continue its magnetic observatory at Apia throughout the period of the survey.

Monochromatic Photographs of the Orion Nebula.

Professor J. Hartmann, in the course of a series of experimental trials of a small quartz spectrograph, has recently obtained photographs of the Orion nebula, which show important differences in the composition of its several parts, indicating that different parts of the nebula emit light of different composition, and that extensive areas of characteristic form shine almost solely with ultra violet light of wave-lengths 3727.

With this small camera the images are, of course, small; 1 mm. on the plate corresponds to an angle of about 10′, but this was found quite sufficient to permit the recognition of the various parts of the nebulous areas. It was found advisable, however, to be able to utilise apparatus of higher power, and this was done by the use of suitably stained colour screens. The most useful of these are: (1) *Picric acid*, which transmits the longer wave-length, especially the nebular lines N_1, N_2, and Hβ, and absorbs all wave-lengths shorter than 4800; (2) *Quinine cobalt*, which transmits only the rays between 3880 and 3740; (3) *Nitroso filter*, the absorption of which begins at 5050, but dies off again near 4000, and 3727 is easily transmitted. By suitable combinations of these, photographs have been obtained with a Steinheil mirror of 24 cm. aperture and 90 cm. focus.

The chief result is the remarkable intensity of the 3727 radiation in *all* parts of the nebula.

XUM

CHEMICAL.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

On Antimony in Rubber Rings.

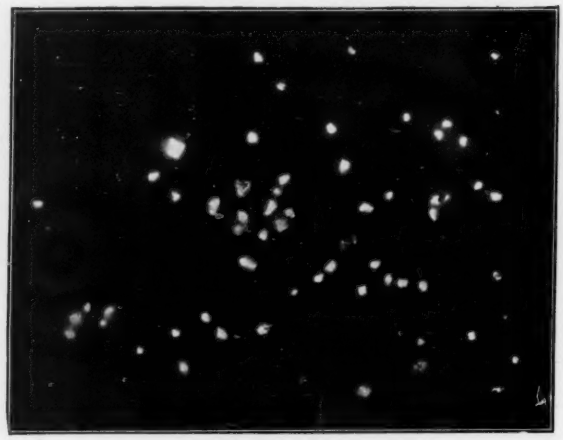
A PARAGRAPH with the sensational heading "Poison in Stoppers" appeared recently in one of the daily papers, and purported to be an interview with a Liverpool doctor. This gentleman was reported to have examined the red rubber rings so largely used for the stoppers of mineral water bottles, and to have asserted that a poisonous dose of antimony could be removed from them by a simple washing with cold water. In fact he is stated to have attributed many deaths within his own experience to this cause. As such stoppers have been in use for over 30 years, and are now almost universally employed, the question is one of the greatest importance, and the present writer has therefore made experiments to determine the degree of truth in the charges here brought against them. These red rings certainly contain a large proportion of antimony in the form of the pentasulphide, and it is to this that they owe their colour. Quantitative determinations showed that the proportion of this pigment in the rubber amounted to 15 per cent. or more. Experiments were next made to discover to what extent this antimony was soluble. The rings were boiled for over an hour with water, but absolutely no trace of antimony could be detected in the liquid. As it seemed possible that in practice the rubber of the rings might become worn and fragments fall into the bottle and so be inadvertently swallowed, parallel experiments were made with hydrochloric acid of 10 per cent. strength, *i.e.*, much stronger than the acidity of the gastric juice; but in this case, too, the liquid was quite free from antimony. This is not surprising, since it is well known that antimony pentasulphide is only soluble in alkalies and concentrated acids; and hence it would seem that there must be some error in the report about the stoppers examined in Liverpool. At the same time it would be advisable for the manufacturers of the rings to replace antimony sulphide by some pigment above suspicion. For although as at present employed the rubber-ringed stoppers may be regarded as quite safe, there are conceivable cases in which the antimony might be brought in solution—*e.g.*, by contact with strong potash. The effects of antimony upon the system are very similar to those of arsenic. Both are irritant poisons, and both are cumulative in their action. It is well known that the dead bodies of the Styrian arsenic eaters remain undecomposed for years, and this preservative effect is also a characteristic of antimony.

The Formation of Radium from Uranium.

A very interesting discovery made by Mr. F. Soddy furnishes new evidence in support of the now generally accepted view that one element can, under certain conditions, be transformed into another. A solution containing over 2 lbs. of uranium nitrate was freed from all radium that it contained by repeated precipitation, and was then kept for 18 months in a closed bottle. It was examined from time to time, and it was found that it gradually acquired the power of emitting an emanation absolutely identical in characteristics with that given off by radium. Hence the conclusion was arrived at that the uranium was very gradually transformed into radium, though only traces of the latter substance were present in the solution at the end of the period of observation.

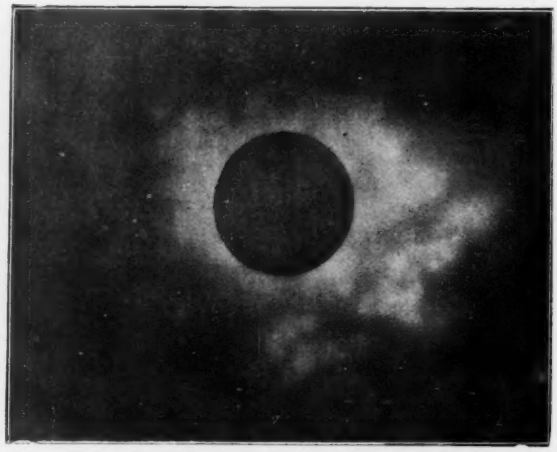
Thorianite: A New Mineral from Ceylon.

One of the most valuable minerals known has recently been examined by Professor Dunstan and Mr. Blake at the Imperial Institute. It is found in the form of small dark cubical crystals in gem-bearing deposits in rivers in Ceylon, the principal source being the bed of the small stream, Kuda Pandioya, but it is not known from what kind of rock the deposit is derived. The mineral varies in colour from dull grey to dark brownish-black, and many of the crystals have a polished appearance from having been worn in the bed of the river. It is nearly opaque, except in very thin layers, is very infusible, and becomes strongly incandescent when heated to a high temperature. Its density is about 9·7. It can be readily powdered, and dissolves easily in dilute sulphuric acid, yielding a gas which consists mainly of helium. It is composed principally of thoria (thorium dioxide), the amount of which ranges from about 70 to 80 per cent. It also contains from 10 to 12 per cent. of uranium oxide and rare earths, and smaller amounts of oxides of lead and iron. One specimen was found to contain 0·39 per cent. of helium. The commercial value of thorianite is due to the free thoria, which is



Action of Thorianite on a Photographic Plate in the Dark.

used in the manufacture of mantles for incandescent gas burners. Hitherto the chief source of this oxide has been monazite sand, which contains only a small percentage of thoria. Consignments of the new mineral from Ceylon have been sold in this country for as much as £1500 per ton. Radium has been identified in thorianite, which is one of the most radio-active substances known, though it is not quite so active as some of the pitchblendes examined by Madame



Radiograph of a Shilling taken through Paper by means of Thorianite.

Curie. The present writer has had the opportunity of examining a number of specimens of thorianite and testing their radio-activity, and some of the results are shown in the accompanying figures. In the first case the thorianite was sprinkled over the photographic plate and left for 12 hours in the dark, and in the second experiment a shilling was placed on the plate and covered with paper, on which the mineral was scattered. It is interesting to note that the radiations must have been reflected beneath the coin in such a way as to obtain an image of the device.

ORNITHOLOGICAL.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

The Slaughter of Ravens and Peregrines.

THE *Field* (July 29) contains a short account of the ruthless persecution meted out to Ravens and Peregrines in Argyleshire, which is anything but pleasant reading. Though we fully realise that these birds, if too numerous, are a menace to farmers and game preservers, there can be no doubt but that anything like a war of extermination is not only unjustifiable, but foolish. The determination and ruthlessness shown by the stalker on the occasion described by the writer are worthy of a better cause; and we are glad to note that he, too, considers the incident regrettable. "Surely," he remarks, "such persecution as that of the raven and falcons might well be stopped, at all events, in the breeding season. The sight of a falcon on the wing is to many sportsmen a real pleasure, and, in my opinion, a few grouse might well be spared to them."

Nesting of the Egyptian Plover.

The remarkable nesting habits of the Egyptian Plover, *Pluvium ægyptius*, have given rise to considerable discussion during the last twenty years or so. The *Field* (August 5) contains an interesting note on this subject, which may be regarded as finally clearing up the matter. Brehm, it may be remembered, stated that this bird buried its eggs in the sand, where they were hatched, while Dr. Von Heuglin, on the other hand, said that he had always found them uncovered. From careful observations of Mr. A. L. Butler, it would seem that Brehm was right. His attention was drawn to the subject by the apparently aimless wanderings of a pair of these birds on a sand-bank on the Rahad River. At last one sat down, and remained seated for nearly an hour. Flushing the bird he endeavoured unsuccessfully to find the eggs. The next day the bird came and sat on the same spot, and a second search revealed two eggs about an inch under the sand. This was at noon, and the sand was burning hot, hence he concluded that the bird visited the eggs at about this time to shield them from this excess of heat, the incubation being performed by the heat of the ground.

Hemipodes Breeding in Confinement.

The value of the work done by the "aviculturist," is slowly beginning to obtain recognition, and no one has done more to bring about this change of opinion than Mr. D. Seth-Smith, who has attained a series of quite remarkable successes in inducing rare types to breed in captivity. After much care and trouble his endeavours to breed the variegated bustard quail (*Turnix varia*) have been rewarded, and he is to be congratulated, for many new facts concerning the habits of these birds at this time have come to light. In the August number of the *Avicultural Magazine* he gives a long and extremely interesting account of his observations. It has long been known that among Turnices the females are the more brilliantly coloured, and that as is the rule in such cases the male undertakes the work of incubation, while the female does the courting. How this is performed is particularly well told by Mr. Seth-Smith in the article referred to. "The male," he writes, "squats among the grass, and the female runs round him. . . . with tail more or less erect, and crop extended and carried close to the ground. Having run round him once or twice she stands facing him at a distance of about a foot. . . . and commences 'booming' or 'cooing' to him like a cock pigeon, at the same time stamping and scratching with her feet, while the male responds with a faint clucking noise." Like the Tinamous, Mr. Seth-Smith believes these birds are polyandrous.

A White Swallow.

Mr. Henry Taylor records in the *Field* (August 12) the fact that a white swallow is daily to be seen at his house at Dyson's Wood, near Caversham. When it first appeared it would seem that the swallows of the neighbourhood endeavoured to drive it away, but they have now apparently grown used to its presence, and in no way molest it.

Dartford Warbler Breeding in Sussex.

The *Zoologist* for August records the breeding of the Dartford warbler at Maresfield, in Sussex, in May last, and the birds appear to have been successful in rearing their young.

Albino Starling.

The Rev. Julian Tuck records the fact than an albino starling was shot at Beyton, in Suffolk, in June last. It had apparently only recently left the nest.

Dotterel in Rutland.

The *Field* (June 3) records the occurrence, at Ridlington, of seven Dotterel, *Eudronias nurinellus*, which were kept under observation in a field for half-an-hour. "Mr. Horn," says the writer, "previously saw the same number at Moscott on May 21.

PHYSICAL.

By ALFRED W. PORTER, B.Sc.

PROFESSOR RUTHERFORD has been making further determinations in connection with the particles emitted by radium. Some of his results may be chronicled here. He finds that the total number of Alpha particles expelled per second from one gramme of radium bromide at its minimum activity is $3{\cdot}6 \times 10^{10}$; and assuming that the composition of the compound employed is $RaBr_2$, it follows that the total number of Alpha particles expelled per second from one gramme of *radium* at its minimum activity is $6{\cdot}2 \times 10^{10}$. Now the Alpha ray activity of radium in radioactive equilibrium is four times this minimum value, and includes three products—viz., the emanation, radium A and radium C—which emit Alpha rays. Hence he concludes that the total number of Alpha particles expelled per second from one gramme of radium in radioactive equilibrium is about $2{\cdot}5 \times 10^{11}$. This result is deduced from the current produced in a nearly perfect vacuum when all electrons (which carry a negative charge) were bent aside by a magnetic field. The close agreement between this value and the value previously obtained from direct data based on the heating effect of radium, and the observed volume of the emanation, leaves now no room for doubt that the Alpha particles carry a positive charge at the moment of their expulsion from the film of radium salt, though at one time he was inclined to doubt that they do. Accepting this conclusion, there is no obvious reason for supposing that they are not charged at the moment of their expulsion from the radium atoms themselves; for it should be noted that the film of radium bromide employed was very thin.

He has also determined that the number of Beta particles expelled from one gramme of radium per second is about $7{\cdot}3 \times 10^{10}$ which is only a little in excess of the number previously obtained for radium at its minimum activity. The results indicate that four Alpha particles are expelled from radium in radioactive equilibrium for each Beta particle, and thus confirm the theory of successive changes which Rutherford has done so much to develop.

If it be assumed that only one Alpha particle is expelled during the disintegration of the radium atom then it follows that the number of atoms which break up per gramme per year is $1{\cdot}95 \times 10^{16}$. Taking the atomic weight of radium as 225, it follows that about half a milligramme per gramme disintegrates per year. It therefore takes about 1280 years for half the radium present to be transformed.

The Pendulum Accelerometer.

Mr. F. W. Lanchester has devised an interesting apparatus for measuring accelerations directly. It is clear that this might be done by mounting on the moving object (*e.g.*, train or motor-car) a spring balance, the mass being mounted so as to permit of its horizontal motion only. The acceleration of the mass (and therefore of the train) would be directly

proportional to the extension of the spring. Mr. Lanchester prefers the easier method of arranging the mass as the bob of a pendulum. This pendulum becomes deflected whenever the point of support receives an acceleration, and from the angle of deflection the acceleration is determined; in fact, the horizontal acceleration bears to that of gravity a ratio equal to the tangent of the deflection. The first instrument of this kind was made by him in 1889. In the 1904 model an improvement has been effected in the mode of automatically recording the acceleration. Since this quantity is proportional to the tangent of the deflection, the recording pencil must be so arranged as to move equal distances for equal increments of deflection. This result is attained by pivotting the pencil arm to the pendulum continuation in such a manner that the point of the pencil lies always in the plane of the pendulum axis. It is assumed in the theory of the instrument that the motion of the pendulum bob is substantially that of the rest of the vehicle, and consequently its motion of swing should be negligible in comparison with the motion of the vehicle. Its time of swing must also be kept small compared with the time of change of acceleration which it is required to record. This necessitates the use of a very short pendulum, which in the later model is reduced to 1¼ inches. An oil dash pot is employed to make the movements deadbeat. A characteristic feature of diagrams taken by means of this instrument is the suddenness of the drop at the instant of stopping. This represents the jerk nearly always experienced just as a train comes to rest. A jerk consists in fact of a very sudden change in acceleration, and not of a large acceleration. Mr. Lanchester suggests that the term "jerk" might be given a scientific meaning by defining it as the rate of change of acceleration. To prevent this jerk the brake of a vehicle should be taken nearly off before completely stopping. For further information the reader is referred to the *Philosophical Magazine* for August.

The Methods of Physics.

In mathematical physics we employ two kinds of theories, which may both lead to an understanding to a certain extent of what goes on in the material world, and which are nevertheless very different in their nature and in the aims which they declare. In the theories of the first kind, it is sought to penetrate the intimate mechanism of phenomena; we endeavour to represent the motion of molecules and atoms, and, as one must now add, also of ions and electrons; we determine their velocities and dimensions, the masses and electric charges of these extremely small particles. All this is foreign to theories of the second kind. Physicists who prefer these concern themselves only with magnitudes which are accessible directly to our observations, such as temperatures, quantities of heat, electric currents, &c. After having measured these magnitudes they establish their mutual relations, and show that these relations are in accordance with certain general principles, amongst which the law of the conservation of energy and the second law of thermodynamics are the most important.—H. A. Lorentz, La Thermodynamique et les théories cinétiques (*Journal de Physique*, August, 1905).

ZOOLOGICAL.

By R. LYDEKKER.

The Lower Jaw of Mammals.

HITHERTO it has been generally supposed that the lower jaw of mammals differs fundamentally from that of birds and reptiles in that each lateral half is formed of a single piece, instead of comprising a number of distinct elements. According, however, to recent investigations on the jaws of embryos undertaken by Professor Carl von Bardeleben, this is a mistaken idea, and in the young condition the mammalian jaw shows the same compound structure as that of a bird or a reptile. The mammalian jaw is indeed now stated to be strictly comparable in every detail with that of a reptile.

Mammal or Reptile?

A fossil skull from the Karoo system of South Africa described in 1884 by Sir R. Owen as that of a mammal, under the name of *Tritylodon longævus*, was subsequently assigned by Professor H. G. Seeley to the reptilian class. Recently Dr. R. Broom, in the Transactions of the South African Philosophical Society, has again pronounced in favour of the mammalian nature of the fossil. Taking all points into consideration, the author believes *Tritylodon* to be a mammal, whose nearest affinities are with the egg-laying duckbill and spiny anteaters of Australasia, which are evidently specialised survivors of a once abundant primitive group. Perhaps the real truth is that the South African fossil presents so many resemblances to mammals on the one hand and to reptiles on the other, that it can scarcely be assigned to either group, but rather forms a connecting link between the two.

A British Armoured Dinosaur.

Not long ago reference was made to recent investigations into the structure of the small dinosaur from the Wealden of the Isle of Wight, known as *Hypsilophodon foxi*. The same energetic investigator, Baron Francis Nopcsa, has published in the June number of the *Geological Magazine* an account of another dinosaurian reptile, *Polacanthus foxi*, from the same locality and formation. The restoration shows a long-bodied reptile of about three feet in height at the shoulder, with the hind-quarters invested in a solid bony shield, and the upper surface of the rest of the body, the neck, and the tail protected by a double row of large bony plates standing vertically. The creature may in fact be regarded as a kind of reptilian armadillo. It may be mentioned that the author takes no notice of the fact that the name *Polacanthus* is preoccupied by the designation applied to the paradise-fish (*Polyacanthus*).

Reptiles from North Greenland.

As affording additional confirmation to the idea that the Arctic regions once enjoyed a genial climate, considerable interest attaches to the description by Dr. E. Fraas, in *Meddelelser om Grønlands*, of reptilian remains from the Jurassic strata of Northern Greenland. The first of these is the footprint of a land dinosaur, while the second is a vertebra of one of the ichthyosaurs, or fish-lizards. It seems, therefore, that in Jurassic times the polar ocean was entirely free from ice.

An Extinct Sea-Lion.

Very little is known as to the past history of the sea-lions and sea-bears (fur-seals), and it is, therefore, a matter for congratulation that a fine skull has been obtained recently from the Miocene strata of Oregon. Mr. F. W. True, who has described the specimen, states that it is considerably larger than any existing sea-lion skull that has come under his notice, its basal length when entire being probably about twenty inches. The new name, *Pontoleon magnus*, is proposed for the fossil sea-lion, as the characters of the skull and teeth do not agree precisely with those of any living member of the group. It should be mentioned, however, that if all the modern eared seals are included in the single genus *Otaria*, as is still the practice with some zoologists, there would apparently be no reason to exclude the fossil species.

The Black Sea Porpoise.

According to the well-known student of the Cetacea, Dr. O. Abel, the porpoise of the Black Sea is quite distinct from the common porpoise of the Atlantic (*Phocæna communis*), the chief difference being apparently the form of the head. For this species the name *Phocæna relicta* is proposed. Seeing that the common porpoise does not enter the Mediterranean, it is only natural to expect that its Euxine representative should be distinct. Dr. Abel considers that the reason why porpoises do not enter the Mediterranean is because the water is too salt for them. In the same communication he describes a fossil porpoise-skull from the Miocene strata of the Taman Peninsula as *Palæophocæna*, regarding it as representing an ancestral member of the group.

Photography.

Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

The Developable Image.—Professor J. Joly, in his presidential address to the Photographic Convention, deals with the nature of the developable image. He considers the change to be of a physical nature, and with due reserve suggests photo-ionisation as the cause, admitting, at the same time, that he has not as yet been able to detect any electronic discharge from the film under light stimulus. I should like to ask whether the wonderful persistence of the developable condition is not a considerable difficulty in the way of accepting such a theory. Whether or not it is supposed that the almost inconceivably minute stimulus that we know to be sufficient to produce the developable condition does so by effecting a change in the electrical condition of the salt, it must be remembered that the changed state of the salt is able to persist for years in an aqueous and salt-containing medium, that is, without insulation, and in the case of the Daguerreotype on the surface of the best known conductor. As Professor Joly says, "our knowledge of the electron as an entity taking part in many physical and chemical effects, should be kept in sight in seeking an explanation of the mode of origin of the latest image," and it is, I submit, of even greater importance to be guided by known facts and experimental data, and to go forward in our conceptions only as these justify our progress. Ionisation may serve well as a working hypothesis, whether or not the future will prove, but I think it should not be accepted even as a possible theory of the nature of the developable image until some definite experimental support can be shown in favour of it.

Measuring Vessels.—I suppose that it is correct to regard weights and measures simply as conveniences, and to value all arguments put forward in favour of this or that system by comparing them from the same point of view. The superior convenience of one system over another may be the merchant's, or it may be his customer's, and then the man of business has to endeavour to find the value of the respective conveniences that he may follow the more profitable course. The practical photographer is not concerned with profits in this matter, but only with minimising his own trouble. Unless one is already more accustomed to the metric system, there can be no doubt that, at present, the ordinary English weights and measures are more convenient for English people, for all English formulæ are so expressed. But among all the arguments set forth in favour of either our present methods or the annihilation of them in favour of the metric system, there is one very practical matter that I do not remember having seen emphasized as it deserves to be, namely, the shapes of the measures in common use. Whether one purchases a two-dram, two-ounce, four-ounce, pint, or quart measure, it is almost always of a convenient shape, but measures on the metric system are tubular. Of course, a narrow tube is better adapted for exact subdivision, but exactness is not the primary desideratum of the practical photographer—an error of a few per cents. on either side of the true capacity is negligible because the effect of the difference is rarely recognisable. The photographer wants convenient vessels for pouring from and into, when a flat dish is the other receptical. I think this simple but very practical matter well worth the serious attention of those reformers who are seeking to get the metric system universally adopted.

Fine Grained Images.—Messrs. Lumière and Seyewetz find that a finer deposit than otherwise is obtained by developing slowly (by adding either water or a restrainer) in the presence of a solvent of silver bromide. For this latter they use from 15 to 20 grams of ammonium bromide to each 100 cc. of developer. Paraphenylene-diamine and orthoamidophenol need no such addition, as developing solutions prepared with them have the necessary solvent power. Working on such lines will probably be found to incur risks not usually met with. Silver in solution is liable to give stains, as with ammonia developers that were generally used before soda developers became so common. I think that the almost universal use of sodium carbonate instead of ammonia is a case of the survival of the fittest, and that it would not be well to go back to ammonia with all its uncertainties. A fine grained image is not everything, and the old wet collodion plate, which is often taken as the standard, if developed with ferrous sulphate, gave a coarse grain, though the particles were more uniform in size than is generally the case in gelatine plates. It is not so much the coarseness of grain in gelatine plates that causes trouble, as the presence of a comparatively small proportion of large grains, some of which appear to be often due to imperfect filtration of the emulsion, for they settle down to the lower side of the film. But granting that the proposed methods are not the best for general adoption, cases may arise where they will be serviceable, and it is very desirable to know the characteristic effect of any possible procedure. In the presence of the solvent of the silver salt, it is supposed (and doubtless it is a fact) that some of the silver that forms the image is deposited from solution, a kind of intensification effect, the other part being reduced, as usual, from the solid particles of salt as contained in the emulsion. It would be interesting to know what effect, if any, the double origin of the developed image has on the gradation.

Received.—J. H. Dallmeyer, Ltd., send a catalogue of their well-known lenses and other specialities. The frontispiece shows the usefulness of the "Adon," which, although a small lens intended for attachment to hand cameras, has here, used alone, given an excellent 12 by 10 photograph with a camera extension of 38 inches.

REVIEWS OF BOOKS.

The Preparation and Mounting of Microscopic Objects, by T. Davies (C. Arthur Pearson; fcap. 8vo, pp. 118; 2s.).—This is a reprint of a book which has had a large sale in past days; and, in spite of certain faults of arrangement, not only was well worth reprinting, but deserved to be reprinted in better style than the "edition" now before us. The book is manifestly merely a new impression from the old stereotype plates of 1873, though this is not mentioned; the binding and the paper have alone been altered—the latter very much for the worse. In fact, the paper is both thick and coarse, and quite unsuitable for the purpose, though the price at which the book is published would surely have justified more satisfactory treatment in this respect. The book itself is too well known to need criticism. It was, of course, written entirely for the amateur; and, though somewhat out of date now, contains much information on preparing and mounting objects for the microscope which is of real service.—F.S.S.

XUM

Half-Hours with the Microscope, by Edwin Lankester, M.D. (C. Arthur Pearson; fcap. 8vo, pp. 118; 1s.).—This is another reprint of a book which has been very popular in its day, but the same criticisms as to paper and printing apply also to this volume. Moreover, the book, dealing as it does in part with the microscope itself, shows its antiquity very markedly, though the publishers refrain from giving any direct information on the matter. For instance, on page 5 a microscope is illustrated which contains almost every feature that the amateur would be warned against now, and on pages 26 and 27 are two "illustrations" which are so worn as to be little better than shapeless smudges. The eight original plates of various objects are in much better condition, and the accompanying letterpress will still interest anyone who has just become possessed of a microscope and is eager to use it.—F.S.S.

Microscopes and Accessories: How to Make and Use Them. Edited by Paul N. Hasluck (Cassell and Co., Limited; pp. 160; 1s. net).—It is difficult to know what to say of a book of this sort. It is one of a series of "Work" Handbooks dealing with such multifarious matters as beehives, boot-making, bamboo-work, &c. It professes to be a "comprehensive digest of the knowledge of microscopes and accessories, scattered over twenty thousand columns of 'Work,' a journal edited by the editor of this book. We have a great sympathy with amateur hobbies, and for all attempts to make things instead of buying them; but we do not think the microscope is a suitable instrument for home manufacture, and this little book, however praiseworthy in intention, confirms us in this. It would be easy to criticise the design and details of the suggested microscope, but we feel that any amateur who is capable of making even such a microscope as is described here, and of fitting it, moreover, with an elaborate iris diaphragm also of his own manufacture, is himself to be humbly admired rather than criticised. Instructions are also given on how to make "an improved mount for a cheap microscope," the result being such as may one day grace the collection of the Royal Microscopical Society as a curiosity, and give rise to much discussion; whilst in Chapter VII. very detailed instructions are given as to how to make a turntable for ringing slides (ordinarily bought by unambitious workers for a few shillings), to fit it with cog-wheels derived from an old egg-beater, and to make also an electric motor to drive it! About fifty pages of the book are, however, devoted to really useful elementary instructions as to collecting, preparing, and mounting objects for the microscope.—F. S. S.

Modern Theory of Physical Phenomena, by Augusto Righi. Translated from the Italian by Prof. Trowbridge. (Macmillan, 5s. net.) The mere title of this little work and the name of its author are quite sufficient to arouse an interest and to give promise of the volume being one worth careful perusal. The author describes it as "an entirely unpretentious book," but it is, nevertheless, one which will appeal to a large number of readers, and will, we feel sure, satisfy their requirements. The chapters on Electrolytic Ions and Electrons; Electrons and Light; the Cathode Rays; Ions in Gases and Solids; Radio-Activity; and the Constitution of Matter, which are described in such a pleasant, simple way, are just such as are in much request at the present time. A "bibliography," or list of papers on the subjects treated of, forms a valuable appendix.

British Bird Life, by W. Percivall Westell (London: Fisher Unwin, 1905).—The number of books which have appeared on British Birds is appalling; and of these only a very few can be regarded as really good of their kind. What excuse there can be for the appearance of the present work we fail to see.

According to the author it presents a series of popular sketches of every species of bird now regularly nesting in the British Isles. But many of the birds included in this list are all but extinct as breeding birds and are nowhere common. On the other hand, a host of birds that are plentiful enough during certain parts of the year find no place in this volume at all, simply because they do not remain to breed.

Of the numerous illustrations scattered throughout these pages we can speak favourably only of the photographs from life, some of which are very good; the original drawings are bad, without exception. Many can only be described as caricatures. W.P.P.

Six Months in the Sandwich Islands, by Isabella L. Bird (Mrs. Bishop) (London: John Murray, 1905 [Popular Edition]; 2s. 6d.).—This is the companion volume to "Unbeaten Tracks in Japan," and it is written in the same charming style. The first letter of the series appears to have been penned on January 19, the last on August 6, 1875. They contain vivid word pictures of earthquakes and tidal waves, human sacrifices, scenery, and domestic customs. Among the last we may specially refer to the practice of *lomi-lomi*, or massage as followed by the Hawaiians. "The first act of courtesy to a stranger in a native house is this (massage), and it is varied in many ways; now and then the patient lies face downwards, and children execute a sort of dance upon his spine!"

Keen powers of observation, and a peculiarly happy style of recording what was observed are evident in every page.

Astronomers of To-day, by Hector Macpherson, Junr. (Gall and Inglis); price 7s. 6d. net. This collection of biographies, accompanied by 27 portraits, should prove of interest to all interested in astronomy, including as it does, an account of the principal doings of many of those, foreign as well as British, of the present day who have made a name for themselves in this branch of science. The series is by no means complete, however, for such names as those of Sir W. Christie, Astronomer Royal; Professor H. H. Turner, Savilian Professor of Astronomy; Mr. W. H. Maw, President of the Royal Astronomical Society; and Mr. Crommelin, President of the B.A.A., are conspicuous in their omission, and there are others that might well have been included, but it is, of course, most difficult to decide on where to draw the line in such a list so as to include the biographies within a handy volume.

Publications of West Hendon House Observatory, Sunderland. (T. W. Backhouse.)—We have received Volume III. of the West Hendon Observatory publications, containing observations of 49 variable stars made in the years 1866—1904 by the author. In most of these observations, except in the case of T Coronæ, the variable differs much in colour from the comparison stars; this makes the probable error greater than in the case of stars of the same colour. In the catalogue given the stars are arranged in order of their Right Ascension, the positions being given for epoch 1900. Then comes the average colour and degree of redness, the spectrum type according to Krüger, and the comparison stars examined.

Pyrenean Geology. Part IV., "The Structure of the Pyrenees; Part V., "Engineering Geology in the Pyrenees;" price 6d. each part. By P. W. Stuart-Menteath, Associate of the Royal School of Mines. Eight parts in all are in preparation, the last to be entitled "The Convictions of the Monkey Mind," the connection with Pyrenean geology being at present somewhat obscure. When speaking from his own experiences in geology, the author is readable, but we cannot see the necessity of introducing into what purport to be geological works personal squabbles and acrimonious remarks concerning those who differed from the author.

A Scheme for the Promotion of Scientific Research, by Walter B. Priest (Stevens).—In this small book a project is set forth in detail whereby an inventor may obtain a public grant for the completion of his discovery. This idea in general is most desirable; but we fear that in practice there would be extreme difficulties in carrying it out. Applications are, according to this suggestion, to be referred to the Board of Trade for consideration. This department, we are inclined to think, would have to be very greatly enlarged to be able to cope with the thousands of applications that would certainly be sent in, and the amounts applied for would undoubtedly run into millions of pounds. We quite agree with the writer, supposing such a scheme could be satisfactorily arranged, in questioning "whether money so employed would not ultimately promote more effectually public interests than much of that now devoted to educational purposes which entail so great a national expenditure."

The Country Gentlemen's Estate Book, 1905. Edited by William Broomhall (The Country Gentlemen's Association, Limited; price 10s. 6d.).—This is the third issue of an annual handbook which should prove of the greatest use to those owning property in the country. It gives interesting articles and information on the management of estates, farming, gardening, forestry, sport, and many other useful topics. It is a large book of over 400 pages with many illustrations.

Notes on Volumetric Analyses, by J. B. Russell, B.Sc., and A. H. Bell, B.Sc.; pp. VIII. and 94 (London: Murray; price 2s.).—This little book contains concise directions for carrying out most of the usual methods of volumetric analysis, and will be found of great use by those who have made some progress in analytical chemistry. It is a new and enlarged edition of the "Notes" published in 1898, the additional matter including various methods of standardising acids. Working details are given at some length in the earlier chapters, but are very wisely curtailed in the latter part of the book, with the object of making the student do some thinking for himself.

Elementary Experimental Chemistry, by A. E. Dunstan, B.Sc., pp. VIII. and 173 (London: Methuen; price 2s.).—If a book on chemistry is to be anything more than a collection of disjointed facts to the student each fresh step must be illustrated, as far as possible, by experimental work. This is never lost sight of by Mr. Dunstan, and almost every page of his book gives directions for simple experiments bearing upon the theory of the subject. Though primarily intended to cover the ground for such examinations as the Oxford and Cambridge Junior Locals, the Chemistry is something more than a mere "cram" book, and we can thoroughly recommend it also to beginners who have not the goal of examination before them. A small point by way of criticism is that a brief description might have been given of the bearings of the recent discoveries about radio-activity upon the atomic theory, for this is no more abstruse than many of the subjects with which the author deals so clearly.

Modern Electricity, by Henry and Hora (Hodder and Stoughton; 5s. net).—This book claims to be a practical working encyclopædia on the subject, and has been prepared with a view of meeting every emergency that might confront the electrical engineer and inventor. The object has been to simplify the information without sacrificing its clearness or accuracy, so that every apprentice and artisan will be able to gain a complete knowledge of the fundamental principles and applications of electricity. These high claims are not always justified. For example, it is not true always to say that an induced charge is equal and opposite to the inducing charge; and in the particular example given they are not equal. On page 21 a question is propounded: Two spheres charged with 4 and 6 units respectively are placed two centimetres apart. What force will they excite on each other? The question is succeeded by the following enigmatical "solution." "Any result equals the force divided by the resistance. The force is 4 multiplied by 6; therefore the resistance must be 2 multiplied by itself.

$$\frac{4 \times 6}{2 \times 2} = 6 \text{ dynes.} \quad \text{Ans."}$$

This solution may be simple; it is certainly not clear. There is too much of this kind of thing in the book for us to be able to recommend it enthusiastically. At the same time there is a great amount of useful information gathered together here in connection with accumulators, decomposing vats, carborundum, central exchanges, Crooke's tubes, lightning arresters, lamps, cables, &c., &c.; and a large number of examples are worked out which will be useful to those who want to get at a result without caring for much refinement in the way they reach it.

The Electromagnet. Underhill (London: E. and F. N. Spon. A new and revised edition).—It is introduced by a capital portrait of Joseph Henry, of Philadelphia, who anticipated Faraday in many of his discoveries. It is an eminently practical volume, and should prove of great service as a reference book to those who are concerned in the manufacture of electromagnets. In the briefest possible space a succinct account is given of all the details which the practician can meet with in regard to choice of dimensions, wires, &c. There are a number of important tables, and also numerous problems to which answers are given. It is very neatly and carefully printed.

Elementary Plant Physiology, by D. T. Macdougal, Ph.D. (Longmans, Green, and Co., 1902. 108 illustrations. Pp. 138).—This is a useful guide in a small compass to the subject with which it deals. Some of the illustrations are very suggestive, and will be of use to the teacher of botany looking about for striking methods of treatment. The chemistry of respiration and digestion is dealt with in an interesting as well as a scientific manner.

Observation of the Total Eclipse.

The following list shows the arrangements for observing the total eclipse on August 30:—

Place.	Observers and Observatories Represented.	Plan of Work.
Labrador. (Lake Melville.)	Dr. King (Ottawa Obs.). Mr. E. W. Maunder (Greenwich). Mr. Perrine (Lick Obs.).	Search for Intramercurial planets. Large scale photographs of corona with 40′ camera.
Spain. (Burgos.)	Mr. J. Evershed.	Prismatic reflector photographs of spectrum of chromosphere and corona.
(Tortosa.)	Rev. J. S. Cortie (Stonyhurst).	
(Oropesa.)	Prof. Callendar, Prof. Fowler, Mr. Shackleton (Royal College of Science).	Experiments on coronal radiation. Photography of red and green regions of spectrum of chromosphere and corona.
	Mr. Campbell (Lick Obs.).	Search for intramercurial planets. Large scale photographs of corona with 40′ camera. Polarisation observations. Spectroscopic photography of chromosphere and corona.
Balearic Isles. (Palma.)	Sir N. Lockyer, Dr. W. J. Lockyer, Mr. C. P. Butler (Solar Physics Obs.).	Prismatic camera (3 prisms) photography of spectrum of chromosphere and corona. Large scale prismatic reflector (one prism) photography of spectrum of chromosphere and corona. Small scale photographs of corona.
(Columbretes.)	U.S. Naval Obs. German Party.	
Algeria. (Guelma.)	Mr. H. F. Newall (Cambridge). M. Trépied (Obs. of Algiers).	Spectroscopic and polariscopic observations.
Tunis. (Sfax.)	The Astronomer-Royal, Mr. F. W. Dyson, Mr. Davidson (Greenwich). M. Bigourdan (Paris).	Photographs of corona on 4″ and 1¼″ scales. Spectra of chromosphere and corona with Major Hills' spectroscopes.
Egypt. (Assuan.)	Prof. Turner (Oxford). Mr. Bellamy.	Polariscopic observations. Corona photographs with Abney doublet. Large scale photographs of corona.
	Mr. Hussy (Lick Observatory).	Search for intramercurial planets. Large scale photographs of corona with 40′ camera. Integrating spectroscope photographs.

Conducted by F. SHILLINGTON SCALES, F.R.M.S.

The Black Currant Gall-mite.

By ALICE L. EMBLETON, B.Sc., F.L.S., &c.

THIS disease is caused by a creature only one-half of a millimetre in length, yet it does enormous damage. Its worm-like body has four short legs near the head, and two long tail bristles. The disease is known to gardeners as "knotting" or "knobbing," and growers are only too familiar with it; yet gardeners (especially cottage gardeners) are often the worst offenders in spreading the pest, for they propagate diseased cuttings on the ground that those particular trees produce best "fruiting buds"—which buds are precisely those that are swollen with the mites, and are worse than useless. In reality there is no difficulty in recognising infested bushes, for the buds are swollen so that they are at least three times as large as normal buds, and it is exactly this that leads to the common error of believing these identical buds to be fine "fruiting buds." While these buds are still green, with a strong magnifying glass, one can see them, when opened, to be literally a mass of the parasites. Such buds usually never open at all, but remain on the stems as brown, dry knobs; if not so badly diseased, they occasionally send out one or two feeble little leaves, but never any more. As the hold of the disease on the plant increases, the effect becomes very striking; the failure of a large number of the buds forces into premature development buds which normally would open the following year, making overdrafts in this way on the plant's vitality; after some time it is incapable of responding to these abnormal calls, for the provision for next year's foliage is already exhausted, and the plant dies.

All the winter the mites, in all stages, from the egg up to adults, are tightly shut up in the buds, and they only begin to come out in the spring—a few pioneers may even be seen as early as March, but the great host get free in May. In the severest frosts, they are unharmed in their protected quarters; in fact, they seem to revel in a hard frost, and it is indeed wonderful how their tiny bodies resist King Frost.

During their migration period, which is from the middle of May to the middle of June, they exhibit curious methods of locomotion; the four short anterior legs are ill-adapted for walking, and yet they continually crawl about at a rate of twelve to fifteen times their own length in a minute; but this only takes them from bud to bud, at the farthest; they get carried further afield by passing insects and spiders, to which they adhere first by the stickiness of their bodies, and then by coiling round a hair or antenna in a worm-like fashion, and holding on tenaciously. This can be shown by lightly touching an open, infested bud with a fine camel's hair brush, when the little white creatures will be found wriggling among the bristles, yet holding on in a determined manner. Their third method of getting about the world is the most interesting. If one watches a community of these mites in a bud under a microscope, one sees them continually standing up on their tails, waving the front legs agitatedly; then they suddenly disappear, and at first it is hard to imagine what has happened precisely. The disappearance is not so accidental as it seems; the animals are, in fact, leaping! The two tail bristles act as springs, and the mite covers about sixteen or twenty times its own length at a jump. It is always seen that after standing upright, waiting for a friendly insect to carry it off on its unsuspecting body, the mite ceases to wave its legs, remains rigid for a moment, and then launches itself forth, torpedo-like, into space. It is an entertaining spectacle to watch, for occasionally, by retaining too firm a hold on the bud, the leap is rendered abortive, and the mite simply falls backwards with considerable impetus, instead of making a clear jump. It is a suggestive fact that while the mites remain upright for minutes in the still air of a room, yet they can be induced to leap at once by blowing upon them. It seems, therefore, that they first try to get an obliging insect to carry them away, and, failing this, take advantage of a puff of air to make their blind leap. Perhaps the mite succeeds in "boarding" a passing insect which hovers near enough to fan it by the beating of its wings.

Having vacated their winter home and crawled. or been carried, or leapt to fresh pastures, the mites enter into the new young buds which are just formed, and so set up the vicious circle again. Myriads are lost, for those which fall to the ground perish, but very few are sufficient to carry on the species for the next year, for they multiply, as soon as they get into the new buds, at an amazing rate. They set up in the new buds at the beginning of June, and by the middle of the month they are all housed (or else they have perished), and the migration period is over, and of the hosts of mites which are turned loose into the world in May, only an infinitesimal number has obtained a footing in the new buds. Reproduction goes on at an almost incredible rate through July and August, and all the winter the tightly-folded buds are crowded with their unwelcome lodgers.

The question, of course, is "how can we check the ravages of these creatures?" and this can only be answered by studying their life-cycle as given above, and carefully considering at which points they are most open to successful attack. In very bad cases it certainly is best to cut down the bushes *in the winter* and burn them on the spot, for the mites are then all safely shut up in the buds, and the bushes can be dealt with in this way without any fear of spreading the pest by shaking them on to other trees, or by scattering them to the winds. Any treatment of the ground under infested bushes is practically unnecessary, as the mites do not live in the soil. As regards spraying, it is manifestly useless during the winter, when the mites are safe in the buds, and here I may call attention to a misleading statement made by the Board of Agriculture (A 1-93—1, Feb., 1893):—"Spraying. . . . in the autumn before the weather becomes cold, and just after the leaves have fallen, if possible. This will economise liquid and labour, and will affect the mites before they get into the buds." I simply quote this in case it is doing damage by being so erroneous, for the mites, as stated above, are already in the new buds in June.

The only time at which spraying can be of use is during the migration time, *i.e.*, from the middle of May to the middle of June, and then, unfortunately, it is undesirable on account of the blossom. On the whole, hand-picking is the only reliable method, and this should be done when they have got into the new buds, for then their number is reduced to a minimum, and the removal of all the new infested buds in July would apparently clear the plants of the disease. When black currants are grown extensively, hand-picking is a serious consideration, yet it is the best method that can be recommended. If this method be adopted annually the disease can be reduced to a negligible quantity within three years. The picked buds should always be burnt carefully, and not "dug in."

Cleaning Desmids.

The cleaning of Desmids is generally somewhat troublesome, and many of my readers may be glad to know of a simple method of procedure adopted by Professor G. H. Bryan, and communicated to the American "Journal of Applied Microscopy." The method to be described is particularly applicable to material obtained from mountain bogs containing submerged plants of *Sphagnum*, among which specimens of the genera *Micrasterias*, *Euastrum*, *Closterium*, *Penium*, and others abound. To collect desmids from this source, a good plan is to squeeze the *Sphagnum* into a wide-mouthed bottle, but the majority of desmid gatherings appear amenable to the same method of cleaning. The apparatus required consists of one or two shallow porcelain saucers or photographic dishes, an old pomatum pot being useful among the number, and a tapered glass tube with a rubber cap, such as a "filler" for a fountain pen. A gauze strainer for a coffee pot is useful for straining out any large pieces of dirt, the stuff left behind being examined for filamentous desmids. The strained material is run into one of the porcelain dishes, and after a short interval—not more than half a minute—the dish is inclined to one side and gently rocked. Any desmids in the gathering will be seen to collect in a bright green line, or patch, at the edge of the receding water, and can then be readily picked up with the pen-filler in an almost pure state. On working round the edge of the dish, the desmids may be drawn into green patches in almost any desired part of the vessel, and one lot after another picked up until there are none left worth troubling about. As the desmids are removed, they are transferred to the pomatum pot, where a drop of Zenker's fixative suffices to fix them. (The formula for Zenker's Fluid is $K_2 Cr_2 O_7$, 2.5 grms.; $Na_2 So_4$ 1 grm.; $Hg Cl_2$, 5 grms; glacial acetic acid, 5 cc.; water *ad* 100 cc. Dissolve the $Hg Cl_2$ and $K_2 Cr_2 O_7$ in the water, with the aid of heat, and add the acetic acid in proper proportions as required, as it evaporates readily.) By repeating the rocking process, the desmids are again collected and transferred from the fixative to another dish containing clean water. They are deposited in a patch in the water near the edge of the dish, and by repeating the rocking, the fixative is gradually washed away, together with any remaining foreign matter. The water should be changed at least once. This method of washing involves less loss of specimens than the ordinary decantation method, provided that care is taken each time to deposit the desmids as close together as possible, for the few desmids that are not picked up in the first attempt are easily collected and picked up subsequently. The whole process takes but half an hour or an hour, so that the fixative is removed before it has time to injure the colour of the specimens.

If much foreign matter is mixed with the original gatherings, the whole may be left in a wide-mouthed bottle in the light for a day or two, when the desmids will collect on the top of the sediment, where they will increase and multiply. The surface layer, containing the desmids, may then be syphoned off and cleaned as before. Even in poor material it is often possible, by the rocking process, to collect with the pen-filler sufficient desmids to mount one or two slides. A somewhat similar rocking process is useful for separating Foraminifera from sand, but the rocking must be a little more violent, and the sand is left behind, unlike the flocculent matter in the desmid gathering, which is swept forward by the water.

To mount the desmids, Profesor G. H. Bryan takes a small piece of parchment paper, say, 1½ by 1 inch, or less, such as is used for packing tobacco, and folds it into a little box. The water with the desmids is placed in the box, which is then floated on glycerine. In two days the water will have diffused into the glycerine, and sufficient glycerine to penetrate the desmids will have passed through the parchment into the box. The desmids are now ready for mounting in glycerine, and have undergone no contraction.

Some desmids, notably *Closterium*, have a tendency to adhere to the bottom of the dish, and then float on the water, but this tendency to float gives similar difficulties when they are washed by decantation. As species of this genus multiply rapidly by self-division, it is usually possible to start with sufficient material to allow of a small loss by flotation.

Action of Wood on Photographic Plates.

In a recent number of the proceedings of the Cambridge Philosophical Society, Professor H. Marshall Ward refers to W. J. Russell's recent memoir in the "Transactions of the Royal Society," in which is described the action of a number of different woods on a photographic plate in the dark. Russell had suggested hydrogen peroxide as the active agent, this re-agent having a definite action upon photographic plates, and the resin in the wood as probably the indirect causal agent, adducing in support the experimental result that while gum-like bodies are inactive, those of a more resinous nature are active. Professor Marshall Ward, as the result of numerous experiments, concludes that the activity is not merely due to resin or resin-like bodies, but that tannin and tannin-like bodies, as well as some others, may also be responsible. It is at least clear that some body or bodies in the liquified cell-walls reduce silver salts in the plate, and that these bodies are either shot off, as if volatile, or diffuse readily, seems clear from the want of sharpness in the microscopic details. Readers will find no difficulty in carrying out the process if they care to try it. The sensitive film of the dry plate is merely placed in contact with the smooth dry face of a wood block and left in darkness for periods of varying length, and the plate on development should show an image of the wood, knots, for instance, being particularly well marked.

[*Communications and enquiries on Microscopical matters should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge.*]

The Face of the Sky for September.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 5.13 and sets at 6.47; on the 30th he rises at 5.59, and sets at 5.41.

The equation of time is negligible on the 1st, the Sun being only 4 seconds after the clock at noon.

Autumn commences on the 23rd, when the Sun enters the sign of Libra at 5 p.m.

Sunspots and prominences are numerous. The position of the Sun's axis and equator is as follows:—

Date.	Axis inclined from N. point.	Equator S. of Centre of disc.
Sept. 1 ..	21° 15′	7° 12′
,, 11 ..	23° 29′	7° 14′
,, 21 ..	25° 9′	7° 2′
Oct. 1 ..	26° 10′	6° 37′

THE MOON:—

Date.	Phases.	H. M.
Sept. 6 ..	☽ First Quarter	4 9 a.m.
,, 13 ..	○ Full Moon	6 10 p.m.
,, 21 ..	☾ Last Quarter	10 14 p.m.
,, 28 ..	● New Moon	10 0 p.m.
,, 1 ..	Perigee 225,000 miles	11 18 a.m.
,, 17 ..	Apogee 252,300 ,,	4 36 a.m.
,, 29 ..	Perigee 222,600 ,,	5 12 p.m.

OCCULTATIONS.—The following are the brighter stars which suffer occultation visible at Greenwich:—

Date.	Star's Name.	Mag.	Disappearance.		Reappearance.		Moon's Age.
			Mean Time.	Angle from N. point.	Mean Time.	Angle from N. point.	
			p m.		p.m.		d. h.
Sept. 4	γ Librae	4·1	7·33	85°	8.37	301°	5 6
,, 10	29 Capricorni ..	5·5	10.21	37°	11.27	287°	11 9
,, 17	μ Ceti	4·4	10.35	42°	11.36	275°	18 9
,, 18	f Tauri	4·3	9.54	65°	10 55	259°	19 9
,, 19	γ Tauri	3·9	10.36	8°	10.59	322°	20 9
			a m.		a.m.		
,, 20	α Tauri	1·1	8.24	26°	9.1	322°	20 20

THE PLANETS.—Mercury is a morning star in Leo; he is at greatest westerly elongation on the 15th, when he rises about 3.45 a.m. This is a favourable elongation for observation of the planet in the morning.

Venus is a morning star in Cancer and Leo; near the middle of the month the planet rises shortly after 2 a.m. On the morning of the 26th the planet will be in conjunction with Regulus, being only 16′ away to the north.

Mars is a feeble object in the S.W. evening sky, setting about 9 p.m.

Ceres is in opposition on the 4th; the magnitude of the minor planet is 7·4, but it is badly placed for observation, being low down in Aquarius.

Jupiter rises about 9.30 p.m. on the 1st and about 7.45 p.m. on the 30th. Towards the end of the month he will be the most conspicuous object in the sky, looking east about 10 p.m.

Saturn, though somewhat low down in the sky, is suitably placed for observation, being on the meridian at 10.25 p.m on the 15th. The planet is a fairly conspicuous object in the evening sky, looking S.E., about 9 p.m., and is easily distinguished by its dull yellowish colour. As seen in the telescope, the planet always appears a beautiful object, and well repays observation. The polar diameter of the ball is 17″·4, whilst the major and minor axes of the outer ring are 43″·5 and 8″·2 respectively; thus the ring plane is inclined to our line of vision at an angle of 11°, the northern surface being visible.

Uranus is on the meridian about 6.30 p.m. on the 15th. The path of the planet lies in Sagittarius, in which constellation he will appear for several years to come. The planet is in quadrature with the Sun on the 24th, and is situated about 2°½ south of the 4th magnitude star μ Sagittarii.

Neptune rises about 11 p.m. on the 15th; he is situated about 6° east of the star μ Geminorum.

Minima of Algol occur on the 8th at 10.20 p.m., and on the 11th at 7.19 p.m.

Mira Ceti is due at minimum on the 17th; magnitude about 8·5.

TELESCOPIC OBJECTS:—

Double Stars.—Polaris, mags. 2·1, 9·5; separation 18″·6. The visibility of the small star is used as a test for a good 2-inch object glass.

ζ Sagittae XIX.^{h} 45^m, N. 18° 53′, mags. 5, 10; separation 8″·6.

a^1, a^2 Capricorni XX.^{h} 12^m, S. 12° 51′, mags, a^1 4·5, a^2 3·8; naked eye double, separation 373″, very easy with opera glasses.

γ Delphini XX.^{h} 42^m, N. 15° 46′, mags. 4·1, 5·0; separation 11″·8. Very pretty double for small telescopes; brighter component yellow, the other light green.

Nebulæ, &c.—Dumb Bell nebula in Vulpecula, nearly 4° due north of γ Sagittae. Rather faint object in a 3-inch.

(M 8) Cluster in Sagittarius; large luminous field of small stars; fine object in pair of field glasses. About a degree E. of the star 4 Sagittarii.

Royal School of Mines.

THE Marquess of Londonderry, K.G. (President of the Board of Education), has appointed Mr. S. Herbert Cox to the Professorship of Mining at the Royal School of Mines. South Kensington, vacant on the death of Sir Clement le Neve Foster. In view of the changes in organisation that may be found desirable in the Royal College of Science and the Royal School of Mines after the completion of the investigations now in progress by the Departmental Committee, it has been thought best to make this appointment a temporary one. Mr. Cox is an Associate of the Royal School of Mines. After experience as Assistant Geologist and Inspector of Mines in New Zealand, he was appointed Instructor in Geology, Mineralogy, and Mines in Sydney Technical College; concurrently with his tenure of this office he was employed to give technical lectures at various mining camps in New South Wales, and practised as a Mining Engineer. Since 1890 he has been entirely engaged in private practice, and has had experience of mining in England, France, Spain, Egypt, the United States, and Canada. Mr. Cox was President of the Institution of Mining and Metallurgy in 1899-1900.

LANTERN SLIDE CABINETS.—Messrs. Flatters & Garnett, of Manchester, have just placed on the market a new form of cabinet for storing lantern slides. They are very compactly built up of various numbers of drawers, each holding 100 slides, and being without grooves damage to the binding is avoided. The cabinets are fitted in such a manner as to render the extraction and replacement of a given slide the work of a couple of seconds. The same firm also offers an improved style of "despatch box" for carrying lantern slides. These are fitted with rubber packing to prevent breakage. Both articles are very moderate in price.